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USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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Machine Tools and Metalworking Equipment

Contents

CEMA COOPERATION IN DEVELOPMENT, PRODUCTION OF MACHINE TOOLS

Moscow EKONOMICHESKAYA SOTRUDNICHESTVO STRAN-CHLENOV SEV in Russian No 9, Sep 83 pp 56-58

[Article: "ENIMS: Setting a Course for Technical Progress"]

[Text] Machine Tool Construction at a New Higher Level

The activity of the Experimental Scientific Research Institute for Metal-Cutting Machine Tools (ENIMS) in the 11th Five-Year Plan is being determined by the tasks proposed in the decisions of the 26th CPSU Congress regarding the fundamental directions of economic and social development in the USSR during 1981-1985 and in the period up to 1990, as well as in other directive documents. It has as its goal the increase of:

OUTPUT OF METAL MACHINING EQUIPMENT. For this purpose are created automated complexes and technological sets of metal machining and control-gauge equipment with numerical programming direction (ChPU), including direction from computers on a micro-electronic base;

PRECISION MACHINING ON METAL-CUTTING MACHINE TOOLS. This problem is resolved by means of the elaboration of new precision machine tools, measuring and dividing machines and other equipment. While these ensure a growth in the technical level of production, they also permit the use of less highly qualified workers;

RELIABLE AND LONG-LASTING WARES, THEIR PARAMETERS AND COMPETITIVE ABILITY. A special importance attaches here to the creation of new highly reliable and rapidly operating sets of electronic drive feed and main movement for machine tools; of complete structures and systems for the direction of machine tools and their mathematical safeguards; of new systems of bearings for swinging and sliding; of new materials and designs for machine tool guidance; of new design for couplings, brakes, spindle assemblies, gear boxes, etc.

Combined Efforts

In the resolution of these tasks, ENIMS cooperates widely with organizations and firms of foreign countries; and in the first with those of the member CEMA countries and the SFRY. For more than 20 years it has had close contacts with the machine tool construction research centers of the People's Republic of Bulgaria [PRB], the Hungarian People's Republic [HPR], the GDR, the Polish People's Republic [PPR], the Socialist Republic of Romania [SRR], the CSSR and the SFRY.

Joint work on the basis of mutual interest in the creation of modern equipment with high productivity, its standardization and unification, is closely connected with delivery of the completed articles to the satisfaction of demands by the USSR, other fraternal countries and the SFRY.

Cooperation today embraces all the fundamental groups of machine tools, including the ChPU, as wellas electro-erosional methods of machining. Questions are successfully resolved regarding the creation not only of individual models, including unique ones, but also of their complexes for the fulfillment of specific technological tasks. Highly effective connections in industrial robototechnology have achieved wide development in recent years. Modern complete articles and assemblies--mechanical, electric and electronic--are being elaborated and introduced in great volume.

The principal criterion in the choice of subject matter for work is the interconnection between scientific research and industrial cooperation. This means that the fundamental supposition is an organization of specialized and cooperative production on the basis of team work.

From Elaboration to Reciprocal Supply

The international connections of ENIMS with closely related enterprises and institutes in other countries--members of CEMA and the SFRY--are, as a rule, of a complex character and include a whole cycle of elaborations, preparations, and tests of experimental models of articles and equipment in series output for reciprocal supply.

Cooperation has spread from the sphere of ordinary commodity circulation, accomplished through traditional foreign trade channels, to the joint creation of new progressive models of machines, equipment and technology, the modernization and raising of the technical level of production output and the organization of cooperative production.

Resolving problems connected with the fuller satisfaction of the demands of the national economy of the USSR and other member countries of CEMA and the SFRY in the production of machine tool-making branches, ENIMS devotes great attention to increasing the effectiveness of scientific research connections. This involves concentrated contacts in the most important directions, specific technical progress and perfection of organizational forms of cooperation.

On a multilateral foundation is determined the long-range direction for the development of machine tools and assemblies (analyses and prognoses); unified normative technical documentation and type are elaborated; dimensional series, connected dimensions and technical parameters of assemblies are unified; standardization is carried out. On a bilateral basis, experimental models of complete articles and equipment are created.

The Production of Assemblies and Parts Is at the Center of Attention

Among the most important practical results of ENIMS' cooperative scientific research and production must be mentioned, first of all, the organization of issue in CEMA member countries of a broad nomenclature for modern complete

articles, including the use of Soviet technical documentation. Among these are electromagnetic couplings, lathe chucks, complete electro-drive feeds with high-speed engines, systems of numerical program direction (TsPU), ball screw pairs, hydro-apparatus, units for refinement and feeding, transport and loading devices, conveyers for the removal of filings, etc.

The coordination of supplies of these items permits, to a considerable extent, the satisfaction of needs for machine tool construction in CEMA member countries and in the SFRY in the form of complete assemblies and accordingly reduces significantly their import from capitalist countries.

The fitting out of domestic metal-cutting machine tools (including the ChPU) with modern complete articles will yield the possibility to accelerate their output, raise their technical level and eliminate, under conditions of serious labor shortage, the necessity of bringing supplementary power into operation.

The following high-quality complete articles may serve as examples of ENIMS' participation in the creation of centralized production of such items in other CEMA member countries: output of electromagnetic couplings and precision lathe chucks in the PPR; transport and loading devices for conveyor belts and hydro-apparatus in the PRB; driving gear feeds with high speed engines in the PRB, PPR, SRR and CSSR.

In addition, in the SRR a complex of work has been carried out to prepare for the arrangement of manufacture of hydrocyclonic installations and cogged couplings of precise indexing; in the PPR the same has occurred for ball screw pairs.

High Effectiveness

ENIMS has achieved high effectiveness of cooperation in the creation of modern machine tools with ChPU and TsPU and their complete articles. This is attested by joint elaboration with specialists in the CSSR lathe machining center for components with a diameter of up to 800 mm; in the PRB, for circular polishing semi-automatic machines with ChPU, to be built into automated parts from such machine tools.

Equipment receiving a "start in life" on the basis of interaction according to technical economic indices (precision of machining, removal of metal in units of time, degree of automation, power provision--main drive capacity) is not inferior to the best foreign models, while the names of the machine tools do not have analogs in world practice.

Connections are developing successfully between ENIMS and enterprises and institutes in the SFRY. Jointly with "Iskra," for example, a system of indications of the LYUMO type was elaborated for lathes and milling machines which have recently undergone successful tests in a group of branch factories. They indicated that the application of these devices, corresponding to the current world standard, permits an increase in machine tool productivity.

Cooperation with the enterprise "Livnitsa Zheleza i Tempera"--LZhT in the city of Kikinda (SFRY) is increasing. Through collective efforts, there have been elaborated interior polishing spindles which have undergone tests and which are also not inferior to analogous articles made by the foremost firms.

Not Only Machine Tools, But Robots as Well

Every year cooperation is intensified in robototechnology also. Special attention is devoted today to scientific research connections in the preparation for production of complete articles for industrial robots: electrodrives, hydropneumatic equipment for drives, devices for programming direction, transmitters and systems of adaptation manufactured for machine tool construction by other branches.

Close contacts also occur in the output of final production. Thus, the second generation robot UM-160, made by the specialists of the Czechoslovakian institute BUKOV, according to the technical documentation of ENIMS, won a gold medal in 1982 at the international fair in Brno. Currently in the CSSR there is a series output of this robot for branches of machine construction in the republic and deliveries are planned for Soviet enterprises.

Today, the specialists of ENIMS, together with their colleagues from BUKOV are successfully working on the creation of a new industrial robot based upon UM-160. It will be called upon to serve machine tools of the drilling, milling and boring group and to assist in the introduction of a different type of automated technological complex. One such complex is intended for lathe machining shafts of from 40 to 160 kg and for components of the shaft and flage type up to 10 kg; others are for finish machining shafts up to 40 kg using circular polishing machine tools.

ENIMS has recently devoted a great deal of attention to the assembly-module principle in the construction of gantry industrial robots. This permits the creation of different arrangement plans of robots on the basis of unified assemblies.

On the Basis of Internal Production and Reciprocal Supply

Still another important direction in the activity of ENIMS is the increase in technical level and quality of reciprocally supplied equipment and the elaboration of new kinds and types of machines. The task consists of providing industry in the USSR and in other CEMA member countries with high production machine tools and reducing the import of these from capitalist countries. A growth in the level of automation and the application of modern cutting tools and complete articles is necessary for this.

The work of the institute for a reduction in imports of machine tools from capitalist countries is a component part of the multilateral activity within the framework of section No 2 of the CEMA Permanent Commission for cooperation in the area of machine construction.

An important role in the increase in technical level and parameters of machine tools is played by their unification, typification and standardization. In the current five-year plan, 59 standards have already been worked out. By the end of 1985 it is planned to increase their number to 120.

At the present time, a project is being elaborated by ENIMS whose conception is the development of specialization and cooperation in machine tool construction between the USSR and other European CEMA member countries up to the year 2000. It foresees a considerable growth in production output and a higher concentration of production. Planned, too, is a further perfecting of the structure of export and import owing to an increase in reciprocal supplies of high production, precision and heavy machine tools, conveyor belts for machine tools and parts from machine tools with ChPU, as well as automated technological complexes.

A guarantee of the successful resolution of these tasks is the broadening and deepening of cooperation among the fraternal socialist countries.

12249
CSO: 1823/146

INSTITUTE'S CONTRIBUTION TO SOVIET WELDING TECHNOLOGY NOTED

Kiev PRAVDA UKRAINY in Russian 4 Jan 84 p 4

[Article by G. Nikolayev, Hero of Socialist Labor, academician, rector of MVTU [Moscow Higher Technical Institute] imeni N.E. Bauman, deputy chairman of the scientific council on the topic "New Welding Processes and Welded Structures" of the USSR State Committee for Science and Technology, under the rubric "The Institute of Electro-Welding--50 Years Old": "The Paton Weld"]

[Text] In history 50 years is not such a considerable period, even in our time, which has been rich in discoveries and achievements. However, in the life of a collective, a lot of unusual things can happen in half a century. Provided it is continually in the vanguard.

The term "Paton weld" is now generally known, and stands as the symbol of the durability and reliability of a weld. And when one speaks of the Paton label, meaning the equipment and technology it indicates, one can be proud that it fully answers to the present-day requirements of scientific and technical progress, and at times even exceeds them.

Just as a mighty tree grows from a very small seed, so the now world-famous major complex, and conjoined institute, its experimental-design and technological bureau, experimental production facility and several experimental plants have grown from a small electro-welding laborartory established by the famous scientist and engineer, Ye.O. Paton.

In the years that I was working on the Scientific and Technical Committee of the People's Commissariat of Means of Communications, and later on the faculty of the welding industry of the Moscow Higher Technical Institute imeni N.E. Bauman, I was often in contact with colleagues in Kiev on the development of welded constructions. We--then still very young engineers--were amazed by the technical erudition of Yevgeniy Oskarovich, his enormous capacity for work, engineering intuition and initiative in setting out new tasks. At the institute, under the leadership of Ye.O. Paton, many fundamental investigations were carried out--thus the foundations were laid for contemporary welding science, the achievements of which have already been put at the service of industry.

The broad employment of welding in our country helped to accelerate the shock tempos at such construction projects of the first five-year plans as Dneproges, the Magnitogorsk and Kuznetsk metallurgical combines, the Stalingrad, Kharkov and Chelyabinsk tractor plants, Azovstal and Zaporozhstal, the Moscow and Gorkiy automotive plants, Uralmash and the Kramatorsk heavy machine-building plant.

The institute did not limit its investigations to the problems of welding steel of ordinary quality. Even greater attention was devoted to establishing methods of welding steel alloys, which was of great benefit to our defense industry in the difficult war years. In the interior, alongside the people of the Urals, the Patonites performed an enormous job, introducing the technology of submerged-arc welding in the production of armored tank chassis, aviation bombs and shells for Katyushas.

But there was no halt to research, the results of which were widely utilized in the postwar rebirth of the national economy, as well as in bridge building.

The remarkable successes of the institute were largely determined by the favorable micro-climate which is rightly called the Paton style of work. An atmosphere constantly reigned here of daring and tireless quest--not an accidental phenomenon, but I would say programmed from the moment the institute was born by the one who created it and headed it to the last days of his life.

In 1953 the baton of the glorious deeds of Hero of Socialist Labor and Academician of the Academy of Sciences of the UkSSR, Ye.O. Paton, was taken up and has been carried up to now by B.Ye Paton--an outstanding Soviet scientist and organizer of science, academician, twice Hero of Socialist Labor, and President of the Academy of Sciences of the UkSSR. Having modeled himself on his father and developed such character traits as persistence and purposefulness, modesty and high principles, and the ability to resolve problems in a stateman-like manner, as well as to educate people, assemble a collective and lead it, Boris Yevgenyevich has done and is doing much for the harmonious development of basic and applied research, and for a highly effective solution to the current tasks of science and practical work.

But naturally, the institute's achievements would have been unthinkable without the talented and, in the very best sense of the word, obsessed people, whose creative labor has generated original ideas and developed and introduced new advanced equipment and technology. This collective has given our country's science such famous scientists as V.K. Lebedev, D.A. Dudno, B.I. Medovar, I.K. Pokhodnya, A.M. Makara, I.I. Frumin, G.E. Voloshkevich, D.M. Rabkin, B.A. Movchan, A.Ye. Asnis, B.S. Kasatkin, V.I. Tryufakov, G.V. Rayevskiy and many others. The majority of the institute's specialists are also on the staff of its in-house plant, and not people on the sidelines. Here, in an inspiring and calm atmosphere they have grown and matured.

It would be difficult even to list all the institute's achievements of the postwar years. The technology of carbon-dioxide welding has been widely

adopted. Contact-butt welding has also been raised to a new technical level for use in joining railroad rails, large-diameter pipes, etc.

Not only the USSR, but also many other industrially developed countries are successfully using the technology of electroslag welding. Further research has led to electroslag smelting, which produces metal of high purity and possessing valuable properties. Then, electroslag casting was also developed, which has provided the capability of manufacturing various important industrial products of diversified configuration.

Work has proven fruitful on electron-beam welding, electron-beam smelting and research on the vaporizing of various substances with the aid of the energy of an electron gun in a vacuum and their subsequent condensation on all kinds of industrial products.

The institute has done a great deal to expand the inventory of welding materials and equipment and to improve welders' working conditions.

There has been wide dissemination of arc methods of welding with dry-fluid activated wires, welding with gas mixtures on an argon base, plasma and micro-plasma processes, explosive welding, various technologies for fusing and spray-coating surfaces and many other methods.

One could produce thousands of examples of the cooperation of the Institute of Electro-Welding with various academic and industrial scientific research institutes, design offices, higher educational institutions and industrial enterprises. For example, our Moscow Higher Technical Institute imeni N.E. Bauman is jointly carrying out with the Patonites work aimed at using mathematical methods and ASU [automatic control systems] to solve problems of the welding industry, and are conducting research on the ultrasound welding of plastics. Specialists of the Physics Institute of the Academy of Sciences of the UkSSR and the Moscow Higher Technical Institute, with the participation of the Institute imeni Ye.O. Paton, have developed at a Moscow plant for drive shafts an automated unit for the laser welding of the drive shafts of ZIL trucks, where great economic impact has been achieved as a result of growth in labor productivity, improvement in the quality of the products and improvement in their reliability and durability.

The work on behalf of welding and specialized metallurgy has been felt not only on Earth but also in space. Already at the beginning of the 1960s, on the initiative of S.P. Korolev and B.Ye. Paton the question was seriously raised as to the feasibility and advisability of welding in outer space. And in 1969 aboard the spaceship Soyuz-6 Valeriy Kubasov performed the world's first welding experiment in space on the Vulcan device, which was developed at the Institute imeni Ye.O. Paton. The experiment demonstrated in principle the feasibility of welding operations in space, and for the future, even the assembly of large orbiting stations from converted structures and individual elements launched from Earth. Advances were also made in space on the results of basic research on the electron-beam vaporization of various materials in a vacuum and on their condensation (experiments on the Isparitel' device).

Jointly with the All-Union Scientific Resarch Institute for Electro-Welding Equipment, the Leningrad Elektrik Plant and the Kakhovka Plant for Electro-Welding Equipment, the institute is now developing a new series of more improved and semi- and fully automated general-purpose machines for submerged-arc welding with a consumable electrode and in gas envelopes. And in the future there will be broad development of automated welding lines, automated operators such as welding robots and robot-equipment complexes, and flexible industrial systems.

A large role in increasing the reliability and efficiency of welded constructions is destined to be played by the replacement of solid metal with laminated metal. Cylindrical, laminated high-pressure vessels, the construction of which has been worked out and studied by employees of the Institute of Electro-Welding jointly with specialists in chemical machine building, have now been in production for several years at Uralkhimmash and are being successfully utilized by several enterprises. The laminated approach is also promising for the welded pipes from which the main gas pipelines are being built. This is especially important in Siberia and other northern regions, where serious difficulties are related to the problem of providing low-temperature resistance for large-diameter welded pipes. The technology developed in the institute has been transferred to the Vyksa Metallurgical Plant in Gorkiy Oblast, where the production of laminated pipe has started.

Patonites have also carried out basic research aimed at developing a new class of metallic materials--quasi-laminated and quasi-solid. Possessing highly valuable properties, they appear to be promising in the pipe industry, in automotive manufacture and in other industries.

At the base of the institute, operating effectively under the leadership of B.Ye. Paton, are the scientific council on the topic "New Welding Processes and Welded Constructions" of the USSR State Committee for Science and Technology, and the Coordinating Committee on Welding, which enlist the major scientists and the leading specialists of ministries and departments, firms and organizations of the country's national economy.

Patonites have also done a great deal to improve the training of specialists in higher educational institutions and among graduate students--not only for themselves but also for other organizations. It is widely known that the institute contributes to cooperation with the scientist-welders of the socialist states--that is, of CEMA members, and to increasing the qualifications of foreign specialists in the developing countries.

It is natural that the institute's efforts would arouse great commercial interest on the part of many foreign firms who hold licenses for the equipment and technology produced by Patonites.

Many of their achievements have been singled out for Lenin and State Prizes. The institute has been awarded the Orders of Lenin and of the Labor Red Banner. But we well know that the energetic collective is not used to resting on its laurels. It sets itself still higher goals, aimed at assisting the further acceleration of scientific and technical progress and the successful

accomplishment of the tasks set forth in the speech of Comrade Yu.V. Andropov at the December 1983 Plenum of the CPSU Central Committee.

And today, when the collective has turned over the 50th, and is starting to fill up the 51st page of its glorious working biography, I want with all my heart to wish my long-time friends and colleagues to: Keep it up! For the glory of our country's science and technology, for the welfare of the Soviet people and on behalf of the strengthening of the power of our native land.

12697
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QC PROGRAM AT DNEPROPETROVSK PLANTS VIEWED

Moscow MASHINOSTROITEL' in Russian No 12, Dec 83 pp 33-35

[Article by A.A. Popov, chairman of the Dnepropetrovsk Oblast Committee of the Machine Tool and Tool Building Workers Trade Union: "The Comprehensive Systems Approach to Economic Control"]

[Text] Enterprises and organizations in the machine tool and tool building industry in Dnepropetrovsk Oblast are completing the third year of the five-year plan with good indicators in production and the economic and social development of the collectives. One important lever in reaching the set targets has been the successful use of a comprehensive system for controlling output quality and making efficient use of resources.

In 1977 the collective of the Dnepropetrovsk production association producing heavy presses was one of the first in the sector to introduce a comprehensive product quality control system [KSUKP]. When the system was being developed use was made of the experience gained by the various leading enterprises in the country in quality control. Initially the system envisaged the development of enterprise standards associated with product quality. Subsequently, by improving and developing the KSUKP and making use of the experience gained by leading enterprises in Dnepropetrovsk, the association collective created enterprise standards that resulted in improvements in production efficiency, the training and establishment of personnel and the organization of socialist competition. Following publication of the CPSU Central Committee and USSR Council of Ministers decree "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality" the system took a new direction, namely the efficient utilization of all kinds of resources. Thus it grew into a fundamentally new product quality control system that insured balanced control over the entire economic mechanism, both its economics on the basis of improving production efficiency, product quality and labor, and the social development of the collective.

One very important feature of the new comprehensive system of quality control and efficient utilization of resources [KSUKP EIR] is that the range of tasks resolved by it has been significantly extended in the direction of improving efficiency and work quality for the enterprise as a whole and for the individual subdivisions and each worker, including improvements achieved through perfecting the special functions of control, which include many tasks. Among these tasks, the following should be noted:

--determining the prospects for raising the technical level of output and the correesponding improvements in production;

--developing products having a high technical level and quality;

--establishing in plans and passing on to the shops, sections and brigades cost accounting indicators that directly determine the results of the collective's activity;

--extensively introducing collective forms of labor organization;

--insuring rhythmic smoothness in production by means of organizing continuous current production planning using modern computers;

--providing enterprises, shops, sections and brigades with raw materials, materials, billets, semifinished products and subassemblies;

--certifying parts, assembly units and technological processes, taking into account reductions in labor intensiveness and the saving of material resources;

--providing moral and material incentive for the labor collectives and their leaders and individual workers on the basis of a system of assessment indicators characterizing each one's contribution to the final results of enterprise operations;

--consideration of indicators for improvements in the quality of output, growth in the volumes of production and efficiency in the use of all kinds of resources, and so forth, when summing up the results of socialist competition.

Development and introduction of the KSUKP EIR (this work was handled in the design-technological section for standardization) were accomplished in three stages. During the first stage (the preparatory stage) technical training was organized for managers and engineering-technical workers and workers and employees. To this end a special course of lectures about the KSUKP EIR was organized in schools of the network of political and economic education. Then, on the basis of an analysis of production activity at the association, specialists worked out a technical task that defined the structure of the system, and they drew up a list of enterprise standards and time periods for developing them, along with a set of organizational-technical measures aimed at improving quality and production efficiency and saving resources. Tasks for quality control and the efficient use of resources are now resolved in 19 functional subsystems based on 156 enterprise standards and other normativ-technical documentation.

It is now 3 years since the association's KSUKP EIR was introduced. It has made it possible to bring order to planning and accountability and tighten control over the observance of technical requirements and organizational documentation. As a result, executive discipline has been improved, responsibility has been enhanced, the facilities available to subdivision chiefs have been extended, and the operation of each subdivision and their interaction have become more precise.

Introduction of the system has accelerated fulfillment of work to raise the technical level and improve the reliability and prolong the service life of forging and pressing machines produced by the association. Merely from the introduction of 316 measures in production, about 3,500 tons of hot-rolled metal has been saved and a saving of about R2.5 million achieved.

The enterprise standards help engineering-technical workers to fulfill their obligations more rapidly and successfully. Thus, as a result of introducing the standard "Operational Plan for Drawing up Technical Documentation" labor productivity for designers rose 10 percent and the time taken for design work was cut 15 percent.

Automation of technical preparation for production using computer technology has made it possible to reduce the time taken to produce technical documentation, improve its quality, and facilitate the resolution of a considerable number of laborious engineering calculations.

With the assimilation of a third-generation computer (the YeS-1035) it is planned to introduce software packages for optimal nesting of rolled plate using a plotter to compile nesting diagrams, developing and introducing remote data processing, making extensive use of display units to display essential online data on request, and speeding up design-and-technological work using an automated design system [SAPR]. The annual saving derived from the use of the automated control system (ASU-PRESS) is R200,000.

The technical creativity of engineering and technical workers at the association has grown considerably. Their personal creative plans include questions of improving output quality, reducing the labor input, making efficient use of all kinds of resources, and improving production standards.

The question of developing and assimilating the output of highly productive forging and pressing equipment and of raising its technical level is being successfully resolved. A new range of battery-driven forging presses with the cylinders mounted above has been assimilated. Their productivity has been improved, fabrication accuracy enhanced, and numbers of operating personnel reduced. Equipping the presses with a hydromechanical system for automatic forging insures the fabrication of forged pieces of first-class accuracy. As a result, an average of up to 2,000 tons of metal is being saved annually per machine. The presses can operate as part of the "Press-manipulator" NC complexes.

The forging and pressing machines produced by the association are equipped with automatic control systems. Forging complexes and sheet-stamping presses with peripheral mechanization are equipped with NC systems. Work is underway to develop second-generation control systems for computer-based forging complexes.

Work to raise the technical level and competitiveness of the equipment produced is being done in cooperation with the scientific research and higher educational establishments. Thus, some 20 themes are being worked on and the saving from their introduction is expected to exceed R1 million.

The rates of technical progress, the fulfillment of production plans, improvement in technical-economic indicators and the social development of the entire collective depend largely on the correct selection, placement, education and training of personnel. The organization of comprehensive and specialized brigades paid according to final results (at present, more than 42 percent of workers are included in brigades, and of these, about 50 percent work with wages allocated according to a coefficient of labor participation) not only makes it possible to improve output quality and make more efficient use of production resources but also fosters greater activeness on the part of workers and their increased political and ideological maturity.

As a result of the introduction of the KSUKP EIR the volume of output has risen considerably: in 1982 the volume of top-quality output increased R1.3 million; the proportion of output (as part of total output) certified with the State Mark of Quality reached about 30 percent (articles in 26 nomenclature categories have been awarded the testimonial five-sided star); over the past 2 years the production of 14 kinds of new output has been assimilated; there have been no complaints about forging and pressing equipment; and 98.6 percent of output is handed over first time. And during the first 2 years of the five-year plan 1,400 tons of metal, 1,300 tons of fuel and 5,738,000 kilowatt hours of electricity were saved. Labor productivity rose 104.3 percent and 120 people, in conventional accounting units, were released.

Work is now being done at the association to further improve the KSUKP EIR. This is aimed at introducing a set of state standards under the title "Control of the Production Association and Industrial Enterprise."

The Dnepropetrovsk Food Machine Building Plant has been operating stably for many years. It is the sector's leading enterprise. In 1981-1982 its collective was awarded a Challenge Red Banner of the CPSU Central Committee, USSR Council of Ministers, AUCCTU and Komsomol Central Commitee.

A KSUKP EIR was introduced there in 1981, based on the enterprise standards. As a result, smoothness was achieved in operations and all workers precisely fulfilled their pledges, and a favorable psychological climate was created in the collective. In the intervening years the State Mark of Quality has been awarded to 10 kinds of output. The absence of complaints testifies to the efficacy of the system at all stages of production. Labor productivity has improved in brigades (in which about 90 percent of the workers are included) where wages are allocated according to a coefficient for labor participation.

Each year 160-170 tons of rolled ferrous metal, 60-[illegible] tons of fuel in conventional units, and 90,000-100,000 kilowatt hours of electric power are saved at the enterprise. This is being achieved by introducing progressive technological processes, improving the design of the machines produced, improving their weight characteristics and cut-out parts, rational utilization of tailings, and combating the irrational operation of equipment, and so forth.

At the enterprise, much attention is paid to technical progress. With the introduction of the KSUKP EIR, each year 35 more people, in conventional accounting terms, are released, the proportion of manual labor has fallen

4 percent, and the level of production mechanization has risen 2.4 percent. The assessments of the quality of labor by executors and subdivisions now made at the plant make it possible to determine with precision the contribution made by each worker to the common cause. And thus is created their moral and material interest in honest and high-quality labor.

In late 1981 a KSUKP EIR was introduced at the Dnepropetrovsk Elektrobytpribor Plant. Here organizational work has been well organized for agitation using visual aids and for publicizing the results of the system's effectiveness. The course of socialist competition in the shops, brigades and sections, the status of quality in output produced, and the economical use of all kinds of resources are regularly reviewed at the trade union meetings. In order to improve the system, a number of standards have been redefined and a graph has been constructed to check their efficacy. With their introduction, the proportion of output gaining the State Sign of Quality has grown to more than 30 percent of the total. Two-thirds of the workers at the plant are included in the brigade form of labor. Losses of work time have been significantly reduced. The labor-intensiveness in articles produced has been reduced almost 5 percent.

Many technical problems are being resolved at the enterprise together with the country's institutes.

Thus, in 1983 the Crimean Planning and Design and Technological Institute is working on a technology for simplifying the parts of foundry molds using a chemical-thermal method that can be applied in prevailing plant conditions. Much attention is being paid to increasing the output of consumer goods. Function-cost analyses are made of the electric samovars being produced. A number of measures have been outlined to reduce their prime cost. In 1984, in cooperation with the Lvov Central Design and Technological Bureau conveyers will be introduced for assembling electric coffee mills and KV-60 electric motors. In order to increase the output of fractional-horsepower motors, an installation will be introduced for the chemical stripping of insulation, and tools for winding the armatures. During 1984-1985 the Armenian Armstanok Scientific Production Association will set up two machine tools for automatic balancing of armatures for the KV-60 electric motor.

Through its own efforts the collective is now reconstructing the mechanical pressing shop, replanning and installing new equipment, and is commissioning a mechanized foundry section. In order to improve product quality, progressive technological processes have been introduced, as, for example, rapid assembly of fractional-horsepower motors and applying coatings to the parts of electric samovars.

In 1982 the saving derived from introduction of the KSUKP EIR was more than R50,000.

Socialist competition for the successful fulfillment of tasks set by the 26th CPSU Congress and the CPSU Central Committee November (1982) and June (1983) plenums, and for ahead-of-schedule fulfillment of tasks in the 11th Five-Year Plan has been developed extensively at the enterprises and organizations in the sector.

In 1982 the collectives of enterprises and organizations in the sector implemented measures to improve labor productivity and make savings on material resources. Some 1,842,000 kilowatt hours of electric power and 76 tons of conventional fuel were saved, and consumer goods worth R381,000 were produced above-plan.

At enterprises in the oblast, under the control of the trade union oblast committee much work is being done to develop the movement for reviewing norms on worker initiative, and new provisions have been introduced for material incentive for workers.

Thus, in 1982, about 10 percent of the piece-workers at the Elektrobytpribor Plant took part in a review of norms on worker initiative. As a result, during the course of 1 year labor-intensiveness in articles was reduced by 15,000 norm-hours and the wages fund was cut R8,500 while the total paid in bonuses amounted to R4,500.

The trade union oblast committee monitors fulfillment of the long-term plan for the development of brigade forms in labor organization and incentive, and it regularly organizes exchanges of experience and gives assistance to plants and shops where these labor forms are being introduced only slowly. The conditions of socialist competition in the sector have been reviewed taking into account mandatory fulfillment of the consumer goods plan, improving labor productivity and providing aid for agriculture. Along with the technical-economic indicators of work, consideration is also given to the fulfillment of measures in the comprehensive plan and the collective contract, observance of the labor laws, the level of losses resulting from illness, and the status of labor safety conditions. Each quarter an analysis is made of plan fulfillment in terms of all indicators. In order to give assistance to shops that are not fulfilling their main indicators they are reinforced with workers from the trade union oblast committee.

According to the results of the all-union socialist competition, in 1983 class places went to collectives at the Food Machine Building Plant, the Elektrobytpribor Plant and others.

The new system of management is also being successfully applied in the planning organizations. Thus, the savings derived from its introduction at the Dnepropetrovsk branch of the Central Planning and Design Bureau amounted to R12,200. Executive discipline has been significantly improved there, which can be seen from the fact that 80 percent of technical documentation is being passed to clients ahead of schedule and the other 20 percent on time. The collective at the branch of the Central Planning and Design Bureau has received commendations on the fine quality and high technical level of the documentation it has produced.

Further improvements are now being made to the KSUKP EIR. Automated control is being introduced for the time taken to prepare organizational-procedural documentation and schedules for the publication of technical documentation, using computers. During the five-year plan work will be conducted on new tasks concerned with automated production control. It is planned to strengthen

the organization's production base, increase the volume of output and introduce the latest achievements of science and technology in developing an automated system for the control of technological processes.

A KSUKP EIR is also operating successfully at the Krivoy Rog branch of the Kiev Institute of Automation imeni XXV s'yezda KPSS. The annual saving from its introduction has topped R15,000.

The sector trade union oblast committee is of great help in solving the problems that occur as the KSUKP EIR systems are introduced in the oblast.

A seminar on leading experience in using the system was held for the trade union aktiv. The course of introduction is regularly reviewed at presidium meetings, and public inspections take place. Much has been done by the trade union committees of the enterprises and organizations to show the importance of introducing KSUKP EIR to every worker. With the active participation of workers at the Dnepropetrovsk Center for Standardization and Metrology, the oblast boards of scientific and technical societies of the machine tool and tool building industry travel out to the enterprises and organizations and give them much assistance in developing and introducing their systems.

Experience shows that a system of active, positive influence on output quality and efficient utilization of all kinds of resources, based on extensive standardization, has been developed and introduced at the sector enterprises and organizations. Much organizational-methodological and ideological work has been done to train specialists who translate into reality the ideas of standardization and quality control. Principles and mechanisms have been worked out for the functioning of KSUKP EIR, including planning, incentive and control using both carrot and stick. Feedback making it possible to assess the effectiveness of the mechanism of state influence on quality established in the country presupposes the establishment of state inspection for observance of standards and quality control.

The introduction of KSUKP EIR has enabled sector enterprises and organizations to not only to successfully fulfill the plans and socialist pledges for the first three quarters of 1983 but also to assume additional pledges providing for the sale of output worth R160,000, the fabrication of more than R200,000 of output, and a reconsideration of pledges for labor productivity growth and certain other indicators. Thus, KSUKP EIR is a powerful lever in the transfer of our economy to the predominantly intensive path of development, as demanded by the decisions of the 26th CPSU Congress.

9642
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STATUS, PROSPECTS OF COMPUTER-AIDED DESIGN DISCUSSED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 11 Mar 84 p 2

[Interview with Doctor of Technical Sciences Yu. Solomentsev, president of Stankin (Moscow Institute of Machine Tools and Tools), head of the chair of automated program control, by correspondent B. Markov: "Our Dialogues: Engineer and Computer": "Training Ground for a Programmer"; date and place not specified]

[Text] Nowadays Stankin graduates are in high demand. Requests for them are coming in from all branches of the machine building industry. The secret of this popularity is simple: the institute's students get good general technical training and, in addition, learn state-of-the-art methods of solving engineering problems, which include the use of computers. Some of the problems of automating the work of engineers are discussed by Stankin president Yu. Solomentsev, doctor of technical sciences, head of the chair of automatic program control, in an interview with our correspondent B. Markov.

[Question] Yuriy Mikhaylovich, only recently many specialists predicted widespread use of automated design systems by the end of the century or even the beginning of the next one. Yet the resolution of the CPSU Central Committee and the USSR Council of Ministers "On Measures for Accelerating Scientific and Technical Progress in the National Economy" clearly states that the development of automated design systems is a task for the present. Why do you think it necessary to step up the automation of the work of engineers?

[Answer] The main reason is that the rate of development of new technology does not satisfy us. This despite the fact that the number of design organizations is increasing faster than ever before. In the last ten years the number of specialists engaged in developing new machines and production processes has increased by 50 percent. However, the results of their efforts are very modest. For example, machine-tool builders themselves estimate that only 10 percent of the metal-working equipment compares favorably with world-class analogues. That, apparently is all that can be achieved if we continue to rely on numbers alone in mastering new, progressive technologies. After all, even a dozen average specialists cannot always replace a single highly skilled one. There can be only one way out, and that is to make the experience and professional knowledges of leading engineers a collective asset. In practice this task can be accomplished with the help of automated design systems.

[Question] Could you give a specific address where computer technology has already served engineers?

[Answer] Not long ago specialists from our chair visited the Ulyanovsk Main Special Design Office of Heavy Machine Tools and Milling Machines. I must confess that initially we had some doubts. What success could the design office claim, we thought, when it had undertaken to set up an automated design system completely on its own, without experience, far from major scientific methodological centers, and with no good technical base to speak of. As it turned out, we found some things we could learn there. Its automated design system has become a truly "collective intellect" to which a specialist can turn at any moment for help and advice from a terminal sitting on his desk.

[Question] How many collectives currently have such a "tool"?

[Answer] Very few, unfortunately. In the machine-tool industry they can literally be counted on one's fingers. And as far as I know the situation is no better in other branches of machine building.

[Question] Yet various organizations and ministries have been developing automated design systems since the early 60s. The poor results of their efforts are in many respects due to the dearth of specialists capable of both placing computer technology at the service of engineers and using it efficiently. The acuteness of the problem is also confirmed by the great demand for Stankin graduates. Many people in the production sphere hold that the higher school is responsible for solving it and state unequivocally that automated design systems will appear only if the appropriate specialists are in place. How justified is this view?

[Answer] I feel that all of us who train personnel for machine building should accept this rebuke. Today quite frequently an engineer with an excellent knowledge of, say, turning machine tools is stumped by a milling machine. Obviously, the gap between a "classical" mechanical engineer and an electronics specialist is even greater. At Stankin we have long been fighting such narrow specialization and have now set ourselves the task of creating an entirely new engineering profession, "mechatronics." The word may seem awkward, but it indicates the essence of the changes: the new type of specialist must become a link between mechanical and electronic engineering.

If, however, we speak of "mechatronics" engineers of so to say the highest class, capable of designing automated design systems themselves, we think there is no use waiting for institutes of higher learning to produce them cut-and-dried for the production sphere. Most of the failures in developing automatic design systems are due precisely to the fact that they were developed by "outsiders," by specialists brought in from outside. The thing is that there is no way they can know all the refinements of real production processes, while their own field is a profound mystery to production engineers. The consequence is the appearance of programs which not only don't work, but they can't even be debugged: there's no one to do it. The developer of an automated design system must be both a programmer and subject-oriented. That is why such a

specialist cannot be trained within the traditional teaching-learning process; he can only be trained, as they say, "for the task in hand."

[Question] Does this mean that, like the Ulyanovsk Heavy Machine Tool Design Office, the branches of industry will have to rely only on themselves to train the main figure in automating engineering work?

[Answer] Of course not. The point is that developers of automated design systems should be trained in the closest contact between the institute of higher learning and the branch of industry. Moreover, this contact should not be only methodological or organizational. Training new types of specialists will require a new technical base and additional funding. Nothing can be achieved without the help of the ministries themselves.

[Question] Judging by appearances the question is one of considerable changes in relations between institutes of higher learning and industry. Can we speak of the specific forms of such relations already now?

[Answer] Currently Stankin has three branch laboratories set up with the direct technical and financial assistance of the Ministry of the Machine Tool and Tool Building Industry, the Ministry of Tractor and Agricultural Machine Building, and the Ministry of the Aviation Industry. With the appearance of these laboratories production has as it were moved into the institute. For the students they are a place of daily production practice. When they leave the institute graduates will continue work begun and mastered there. For the supervising industry such a laboratory is a kind of proving ground. It has already become customary to see, say, a factory designer working together with our programming instructor and students on a problem modelled for an automated design system already operating or newly developed for the industry. It is in such collaboration of the industry and the institute of higher learning that we think the problem of training leading personnel for developing automated design systems can be most effectively solved.

[Question] But from this it follows that even given active initiatives on the part of the ministry only those places which already have or are building automated design systems can look forward to obtaining such specialists. Yet the manufacture of hardware for automated design systems will expand rapidly, as required by the resolution of the CPSU Central Committee and the USSR Council of Ministers. It seems obvious that in such circumstances the absence of trained personnel to master it will result in major losses and downtime or inefficient utilization of expensive progressive equipment.

[Answer] The danger is indeed there. However, I think it is rooted not in any shortage of developers of automated design systems. The number of specialists required is not all that great. What is required of the rank-and-file engineer is to become a knowable user of automated design systems, which requires a substantially smaller volume of knowledge of computers and the fundamentals of modelling a specific range of problems in machine language. Mastering such knowledge is not all that difficult. It is not accidental, however, that so much is being said today of the psychological barrier as one of the main obstacles in the way of computer technology. Even we in our institute had to

devote major efforts and much time to overcoming it. For the question is, strictly speaking, not so much of additional knowledge as of fostering new professional and psychological qualities and higher work standards in engineers. Doubtlessly, in this field we can learn a lot from the pioneers of automating engineering work, and perhaps the most important lesson is not to undertake the development of automated design systems from scratch: it is initially essential to accumulate at least some elementary experience in computerized engineering calculations.

[Question] But this seems to be a vicious circle: How can one hope to accumulate experience if the designer's tools are limited to a drawing board, slide rule and, at best, a pocket calculator?

[Answer] That is indeed so. We often hear much the same from students returning from their practice training: What's the use of giving so much attention in our curriculum to mathematical methods and automated design systems if no one uses computers at our future places of work? The picture, as we see it, is indeed a sad one: Although there are thousands, if not tens of thousands, of computers in machine building, only several hundred are used for engineering calculations, although that is just where they could yield the greatest effect. There may be different reasons for this state of affairs, but only one conclusion: it is necessary to give engineers access to this hardware without delay.

[Question] In other words you suggest that all the nation's engineers should as it were go back to school?

[Answer] Yes, that is the requirement of the time. One can only hope that realization of this necessity will acquire the most practical and uncompromising forms. Like, say, at the Ulyanovsk Heavy Machine Tool Design Office and the Moscow Special Design Office of Automatic Transfer Lines and Modular Machine Tools. Incidentally, teachers from our institute helped the Muscovites to learn the principles of automated designing. After a 400-hour course directly at the special design office its specialists quickly mastered new work methods and were soon able to computerize the problems they had mastered so as to free themselves for more complex jobs. Today already more than a thousand engineers and technicians are training at the Ministry of the Machine Tool and Tool Building Industry to be users of automated design systems. That, of course, is not much. However, as far as we know, in some industries nothing at all is being done to teach engineers new methods.

There are other difficult problems on the engineer's ways to computer technology. However, to get back to the beginning of our conversation, I would like to reaffirm that the automation of engineering work is an urgent task. The main thing needed to resolve it today is the readiness of specialists to master computer technology.

9681
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METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

UDC 621.919.3

NEW ROBOTIZED, VERTICAL BROACHING MACHINE FEATURED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, Mar 84 pp 7-9

[Article by engineers K. Ye. Levin, A. Z. Tsymkovskiy and V. A. Yaroshevich: "Vertical-Broaching Machine Tool for Internal Broaching with a Broach Magazine"]

[Text] At metalworking enterprises with small series production, broaching of round and splined holes, keyway grooves in gears and flanges is done basically on types 7B55 and 7B56 horizontal broaching machine tools. Because of the small output and the wide list of the machined parts, setting-up and removing parts, as well as bringing down and moving the broach away are done manually. Labor-intensive readjustment of the machine tool is required when machining various parts.

The Minsk Machine Tool Building Plant imeni S. M. Kirov manufactured and introduced a model 4MP637 vertical broaching automatic machine (Fig. 1) [not shown] of the processing center type for internal broaching with a broach magazine according to drawings of the special Design Bureau of Broaching Machine Tools.

This automatic machine tool is the first in domestic and foreign machine tool practice that provides for machining under conditions of small series and series production of a wide nomenclature of parts according to a given program without manual readjustment. The machine is intended for broaching round and splined holes, as well as keyway grooves and other internal surfaces. The use of this machine makes it possible to double and triple productivity, especially in machining heavy intermediate products, as well as to improve labor conditions and raise the production standard.

The special design features of the machine are as follows:

availability of a tool magazine for 30 broaches with a system for an automatic search for any broach when machining in one pass, as well as two or three broaches in a given sequence when machining in two or three passes;

the machine tool is three-positional so that each of the three working positions machines a certain part of the dimensional range of the intermediate products;

there is automatic adjustment of the length of working travel and the length of auxiliary carriage travel depending upon the broaching length;

the automatic machine is equipped with a manipulator for loading and unloading parts automatically;

the machine has auxiliary mechanisms for bringing out the proper number of broaches from the magazine for two-or three-pass machining into a mechanism to feed the broaches for multipass machining. This reduces the cycle time and provides higher reliability of operation.

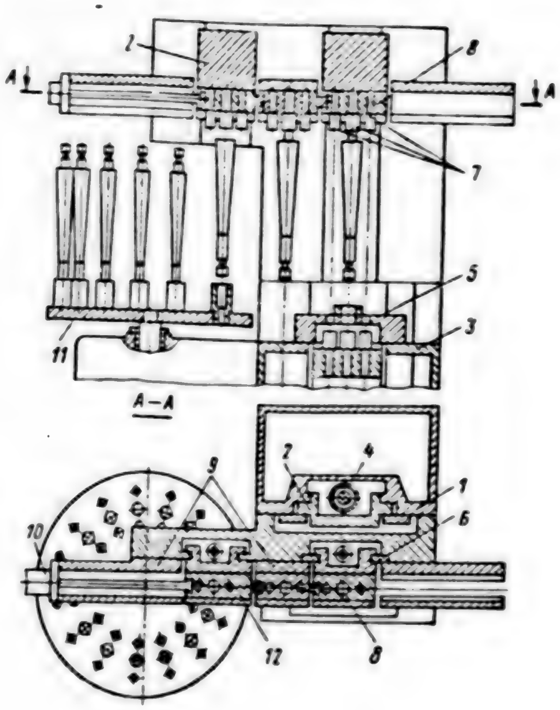

Fig. 2. Arrangement of vertical broaching machine tool

Fig. 2 shows the arrangement of the machine. The following units: bed 1, slide bar 2, pedestal 3 and hydraulic drive 4 were borrowed from the type 7B661 or 7634 broaching machine tools previously manufactured. Three chucks are located in the slide bar for various diameters of tail ends of broaches, for example, 36, 50 and 22mm. Table 5 has three holes for the external diameters of broaches, for example, 60, 115 and 35mm. Three auxiliary chucks 7 and housing 8 are located on auxiliary slides 6. Housing 8 can move in the horizontal direction in guides 9. On the same guides, there are mounted two other housings with similar auxiliary chucks, coupled together and capable of moving vertically. Horizontal motion of the housings with the auxiliary chucks is provided by hydraulic cylinder 10.

All broaches for machining the established nomenclature of parts are located in magazine 11 above which are mounted, in parallel with the auxiliary ones, additional slides 12 for removing broaches needed for work from the magazine.

Machined parts with external diameters of 60 to 350mm, 20 to 160mm high and weighing up to 40kg are loaded and unloaded by a manipulator, while parts with an external diameter of 350 to 500mm and 160 to 250mm high are handled manually. The machined parts are stored on removable pins.

The necessary broach transfer from the magazine to the machine tool is as follows. The magazine, turning, positions the needed broach under the auxiliary slides. The latter lowers with one of the housings and the auxiliary chucks and one of the chucks seizes the broach and moves it up. After the horizontal guides in the auxiliary slides line up with the stationary horizontal guides, the housings are moved by the hydraulic cylinder to the machine tool until the housing lines up with the broach with the auxiliary slides.

After the installation of pins on the manipulator base with a lot of parts machined by the given broach, the machine tool is ready for operation.

When machining parts sequentially in two or three passes with two or three broaches, the latter are removed by additional slides from the magazine and placed in housings on the horizontal guides. Then the machine tool processes automatically to operate on a lot of parts with a change of broaches after each pass; between passes the manipulator removes the part for completion of the reverse pass, and then places the part on the table again.

After machining a lot of parts, one or several broaches are returned to the magazine in a similar way in reverse sequence.

2291
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OTHER METALWORKING EQUIPMENT

DEVELOPMENT, IMPLEMENTATION OF INDUSTRIAL LASERS REVIEWED

Moscow SOVETSKAYA ROSSIYA in Russian 27 Mar 84 p 1

[Article by N. Rybakov: "The Laser Beam Competes With the Cutting Tool"; under heading: "The International Metalworking Exhibition "Metalloobrabotka-84" opens in Moscow Today"]

[Text] ENIMS [Experimental Scientific Research Institute of Metal-Cutting Machine Tools] developed the first laser systems for industry relatively recently--only ten years ago. In place of the usual cutting tool these systems used a laser beam, thanks to which the watchmaking plants markedly reduced the labor involved in drilling holes in ruby bearings.

But up till now there has not been any equipment available to drill with high precision holes of complex configuration in such hard-to-machine materials as ceramics and diamonds. In this regard a new ENIMS machine is unique. I saw it in action at the Metalloobrabotka-84 diaplay. The machine is being readied for series production.

V. A. Katulin, deputy director of the Lebedev Physics Institute of the USSR Academy of Sciences (FIAN), doctor of physico-mathematical sciences, and laureate of the USSR State prize, recalls: "When we created the first laser we had no instruments for measuring the power of its beam. We initially evaluated its power on the basis of the number of stacked razor blades the beam could penetrate. It was clear even then that we had at hand a new and very effective tool for machining materials."

Lasers comparatively quickly found application in communications equipment. The beam can accomodate and transmit a tremendous amount of information. While FIAN worked to increase the power and efficiency of the lasers for machining materials, their properties were indispensable for technical diagnostics. This sphere of laser beam use has now found wide application. For example, a prototype of a diagnostic laser system for screening bearings has been developed and tried out in the Kuybyshev branch of FIAN. Surface defects of only five to ten microns in dimension can be detected with its aid.

Katulin continues: "The fundamental possibility of developing industrial lasers with power to 10 kW and efficiency to 40 percent has now been shown. We have large hopes in this regard for the oxygen-iodine laser. The energy source in this laser is a chemical reaction, for which we use readily available and inexpensive components such as hydrogen peroxide, chlorine, and alkalis. The use of such a system for machining materials promises significant savings. Carbon dioxide lasers and lasers using various crystals have already proved out well in industry. Tens of such systems are in operation in Kuybyshev enterprises alone. The "Kvant-16" system is working out well in the Fourth State Bearing Plant.

All the known machining modes can be performed with the aid of the laser. However this is not always profitable. Therefore lasers are used today only where they can provide significant savings."

The Soviet exhibit also includes several examples of equipment which is only beginning to appear in world practice.

For example, an automated design system. Its console faces three screens. The operator dials in the parameters of the part. Then these parameters enter the computer and the latter "mentally" generates a drawing of the future article. Thus, bypassing the drafting machines, the drawing travels over wires to an electronic machine that controls the machine tool.

Yu. P. Zavgorodniy, director of the Scientific Research Institute of Information on Machine Construction and a member of the working group of the exhibition organizing committee, says: "The Soviet exhibit includes more than 300 displays, and enterprises and firms of 22 countries are participating in the exhibition. This is the first time that such a large review of metalworking equipment has been held in the USSR, which delivers such equipment to nearly 70 nations. Metalloobrabotka-84 will confirm and improve the authority of our machine construction industry in the international marketplace."

9675
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INDUSTRY MINISTER ON FMS, MANAGEMENT AUTOMATION

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 18 Apr 84 p 4

[Article by M. Shkaradnya, minister of Instrument Making, Automation Equipment and Control System,"Orientation on Flexible Production"]

[Text] Technical progress is continuous. Each of its stages, however, has its special features. Today we entered the software period: machine tools with NC, intrashop transportation with computers on board, automated warehouses, SAPR [Automatic design system], ASUTP [Automated system for technological process control] -- all these are components of automated production facilities. Frequently they are called flexible or "unmanned." So far there are few and they are still far from being unattended. However, they are available and with all their imperfections they make it possible to affirm that tomorrow's enterprise will be distinguished by high productivity in combination with a high level of flexibility, i.e., the ability to be readjustable for producing new products.

But how can we correlate the problems of forming production facilities of the future with today's current problems faced by collectives of enterprises and sectors? This statement of the problem, as far as I know, evokes many disputes and arguments between various viewpoints. Many feel that flexible automated production facilities are the business of the next century and may be attractive to management only as an interesting, impractical experiment. A significant argument may be added to this position as follows: a certification of the enterprises in the sector indicated that every fourth one of them does not even fit the requirements of today's level of technology and organization of production. How can one seriously approach the formation of plants of the future with such baggage?

Nevertheless, we began. Moreover, we think that there is simply no other way out.

We will start with those problems that were posed to the sector. I will not enumerate them. I will only say that practically all programs for developing automatic equipment in the country, from NC devices to systems for controlling metallurgical production facilities and all petroleum refining, in one way or another, involve instrument making. If to this is added the sharply increased demand for monitoring-measuring equipment, it becomes understandable that the

sector got the task of increasing the production of this equipment by 1.4 times in the current five-year plan period. For a number of groups of devices and computers we must double and even triple production.

But by itself quantitative growth does not define even half the problem, even taking into account the increase in output that we have obligated ourselves to produce without increasing the number of workers. Of considerably greater concern to the instrument makers is the necessity of renovating the products constantly -- in this five-year plan period we are obligated to change half the product list. This involves some 2500 products which must not only be developed, but the facilities must also be rebuilt for series production of the products.

I will name still another problem. When, due to a failure in an NC device, a machine tool stops, it is, of course, unpleasant but tolerable -- after repairs it will operate again. But here we connected together a machine tool, a robot and an automated warehouse and produced a so-called flexible module. Programed devices provide normal capacities to each type of equipment individually, yet the system as a whole may become inoperative -- idle time increases sharply because failures are superimposed upon each other. An entirely different level of reliability is required and to achieve it, a considerably higher level of technology and organization of production is required.

Other arguments could be cited but I think what has been said is enough to conclude that without extensive reequipment of the enterprises in the sector, it will be impossible to give the national economy the products required from them. Modern progressive equipment, which is equipment with programed control, has one distinguishing special feature -- it cannot be inserted into traditional production facilities. This was graphically demonstrated at the first stage of introducing machine tools with NC, when an attempt was made to use them to eliminate bottlenecks and one or two of them were scattered in various shops. Today, it is clear to everyone that they begin to show a yield only when they are assembled in a single section, or still better -- in a shop.

The efficiency of this approach increases sharply when the SAPR is used which, as is well known, makes it possible in many cases to do without drawings and developing technology, issuing ready programs directly to machine tools with NC. Robot equipment, automated warehouses and transportation facilities are easily inserted in such sections and shops. In this case, practice shows that the yield from the invested money increases correspondingly as we come closer to flexible automated production.

This is the inner logic of modern equipment. It is quite natural that the tactics of reequipment must take this into account; otherwise we not only do not bring tomorrow closer to the sector, but we also do not solve today's problems. That is why using flexible automated production facilities gives this direction exceptionally serious importance. In the socialist obligations of instrument makers for this year, positions related to reequipment of enterprises are among the most important ones.

Since the start of the current five-year plan period, increased production capacities by reequipment at about 800 million rubles, over 70,000 workers were conditionally freed and the production cost of products was reduced by over 215 million rubles. The first quarter of this year was good. Almost 1500 robots were added to the 8000 already in the sector. Work in 19 robotized sections proceeds according to schedule. Specialists of the Mogilev and Ramen "Tekhnopribor" plants started the introduction of flexible automated machining production facilities. The correctness of the tactics we chose is confirmed also by the fact that the sector coped fully with plan tasks for the first quarter.

But not one program is able to take into account the specifics of an individual enterprise or envision the sequence and nature of its reequipment. Understanding this quite well from the very start, we used in our practice the so-called first person principle where the full responsibility for fulfilling set tasks is carried by the director of the association, plant or institute.

This measure was taken not only by the desire to increase the authority of the sector's program, but to guarantee the implementation of the plan.

Our experience indicates that psychological rearrangement is an exceptionally difficult and painful matter, exceeding all technical obstacles in complexity. This can be especially graphically demonstrated in the example of robotization. Within the framework of the sector program we planned to manufacture and introduce 30,000 robots in five years. We have already worked on this for three years very seriously; we have already introduced 8000 robots and 7000 more are planned for this year. But we still cannot say that all enterprise managers are facing the problem.

The complexity of changing a manager is made more difficult by the fact that a good director is always a strong personality. Frequently the personality is "prickly" with its own opinions and style of work. It is impossible not to take these individual features into account. Let us say, the Kiev "Tochelektpribor" was somewhat slow to start. But knowning the nature of the Petr Andreyevich Shilo, its general director, who never grasps at things in the heat of the moment, we were in no hurry to draw conclusions. Now production robotization in the association is proceeding well.

All these circumstances require flexible tactics from the staff of the sector which would combine strict demands and supervision and an individual approach to the specifics. For these purposes we hold out-of-town director councils and industrial conferences which make it possible for them not only to hear, see and touch with their own hands, as they say, the new equipment and the new organization in action. This produces good results and already a serious shift is noticeable. Regrettably, judging by everything, not all managers pass the test of the modern style of thinking. This being so, it means that they cannot competently organize the work of the collectives. Here one must use radical measures.

In conclusion I would like to state the following not indisputable thought. Instrument makers are frequently blamed for parallelism, for striving for natural management. At first glance, not without basis. We developed a fairly strong production of robots and manipulators for the needs of the sector. The "Soyutekhpribor" All Union Production Association specialized in that almost entirely; cooperation was organized between enterprises. At present we are strongly developing the capacities of tool shops and mechanization and automation services, considering that without good support units, capable of manufacturing good fixtures rapidly and individual types of equipment, we could not cope with the reequipment problems.

Recently we studied the SAPR thoroughly and arrived at the conclusion that the development rate in this most important direction cannot satisfy us. One of the reasons is the acute shortage of individual kinds of equipment. Their output is not within the specialization of our ministry. However, when we studied the real situation in this area, we decided to organize the production of the needed equipment by ourselves.

In my opinion, the academic concept of specializing does not take into account, in a number of cases, the actual condition of the economy, especially of those qualitative changes that occur now in the means for production in machinebuilding and instrument making. In fact, when robots appeared it became evident that this was precisely the link that machine tools with NC lacked. At the same time, an acute demand for them originated in many sectors. What to do? Wait until the necessary capacities are developed according to specialization and a possibility appears to satisfy the hunger for progressive equipment? But tis means that each day is charged with great losses. Therefore, industry replied to the created situation by the simultaneous start-up of robot equipment developers in various sectors of industry.

A similar situation is developing now with the SAPR. It is quite obvious that losses from duplication are insignificant as compared to the effect of the rapid satisfaction of the need for this missing link which will be able to close the circuit and produce conditions for a sharp increase in the rate of technical progress.

The acceleration of the robotization process, of the development of flexible automated production facilities and unattended technologies, in our opinion, is the main road to an essential increase in the efficiency of production. And, in the final account, this is the goal that is faced by the sector and toward whose achievement our reequipment policy is directed.

2291
CSO: 1823/219

INDUSTRY MINISTER ON STATE, FUTURE OF ASUTP, FMS IN USSR

Moscow EKONOMICHESKAYA GAZETA in Russian No 16, Apr 84 p 7

[Article by M. S. Shkabardnya, minister of Instrument Making, Automation Equipment and Control Systems: "Automation -- Basis of Intensification"]

[Text] Instrument making belongs among the sectors that determine the rates of scientific technological progress in the national economy, and directly affect the production intensification process. In our country, according to joint programs with ministries and customer departments, automated systems for controlling processes are being developed and introduced in ferrous and nonferrous metallurgy, machine building, chemical and petrochemical industries, in construction, transportation, the agricultural-industrial complex and in the nonproductive area.

The enterprise collectives of the Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] are now facing great problems on implementing the Power and Provision programs of the country, and producing consumer goods. It is advisable to describe these most important aspects of the work of the sector in greater detail.

According to plan, our sector will supply 85 ASU [Automatic control systems] and ASU for technological processes to the fuel-power complex of the country.

Automatic control systems were developed and introduced for high unit capacity power units, gas-lifting petroleum production installations, and gas and petroleum pipelines. Orders for nuclear electric power plants are increasing steadily. In 1983, 3.5 times more devices and automatic equipment were manufactured than in the first year of the five-year plan period. Last year, 1.7 times more computers were supplied to AES than in 1981. These rates continue to grow.

Equipping the high priority AES -- the Kola, Kalinin, Balakovsk and others occupy prominent places in the plans of our enterprise this year. As shown by summaries of the past quarter, these deliveries are strictly on schedule.

The production of modern power giants, especially nuclear ones, would be simply unthinkable without high precision, reliable, high speed devices.

The introduction of modern devices makes it possible to service electric power plants, petroleum and gas-producing facilities and pipeline mains with a smaller number of people, reduce consumption and losses of electric power and fuel and increase the reliability of the power supply. Of special note are such developments of the ASUTP [Automated system for technological process control] of the Berezovsk GRES and the Sayano-Shushan GES, the Saratov, Pavlodar and Ryazan' petroleum refining plants and the control system for producing gas at the Urengoy Deposit and the Urenga-Punga-Nizhnyaya Tura gas pipeline.

According to the "Kachestvo" sector program, measures are being taken to increase the operating reliability of the technical equipment supplied to power facilities. Equipping them with modern computers, including microprocessors, required a new approach to technical servicing at the consumer's when installing and adjusting them as well as during the period of operation. Such work is already being done by the "EVM-servis" Production Association organized at the Minpribor.

Along with increasing the volume of deliveries, new types of devices and automated control systems were made for the APK [Machine for feed preparation] sectors. In 1984, some 32 new instruments were developed and mastered, and 45 ASU and ASUTP were introduced at various agricultural-industrial facilities.

In 1984, Minpribor enterprises will supply to agricultural-industrial sectors 1.7 times more products than in 1982 when the Provision program of the country was adopted.

The above-stated is a fairly serious problem for the enterprises and organizations of the country. In 1983, our deliveries to the APK increased by 1.3 times. The task for the past quarter was overfulfilled by 2.2 percent.

An ASUTP for egg incubation was put into operation at the Issyk-Kul'sk Poultry Factory. The automatic system increases the yield of chicks by 1.3 to 1.5 times. Over a half million rubles is saved. According to a joint program by Minpribor and the USSR Minsel'khoz [Ministry of Agriculture] 14 such ASUTP will be introduced by the end of the five-year plan period which will make it possible to raise the level of producing chickens and eggs to a new technological level.

An ASUTP introduction at the Glodyansk Conservation Combine in Moldaviya reduces losses of raw materials considerably, and as a result, reduces the production cost of the finished product. This system makes it possible to increase the productivity of technological equipment by 2.5 percent.

New ASU introduced at the Mozyrsk Yeast Plant increased the output by 20 percent and production cost by 18 percent. Such systems will also be introduced at other plants of the Glavmikrobioprom [expansion unknown].

Recently series production was mastered of four type-sizes of automobile scales with data recording by microprocessors. This increased considerably the accuracy of the equipment, its reliability and convenience in handling. Such scales are intended for heavy trucks, tractor-trailers, elevators, mills

and mixed feed plants of the USSR Minzag [Ministry of Procurement], and enterprises of other APK sectors where it is necessary to measure large, multiton loads of various materials accurately. This year other types of automatic scales for certain technological needs will be produced.

One most important joint work with the USSR Minsel'khoz is the development and introduction of high productivity equipment for analyzing soils and feeds. What already has been done cannot be considered fully successful. Therefore, the Tbilisi "Analitpribor" Production Association is developing intensively new high productivity equipment, using modern analytical equipment and means to process data by microprocessors. At present we are confident that we will cope with this problem. Minsel'khoz enterprises must prepare seriously to accept such equipment for operation and, first of all, train the required personnel. The skill of the service personnel determines greatly the success in this matter.

Over 100 of our scientific research institutes and design bureaus are participating in developing cultural-personal services and household goods. Here are involved not only watch and jewelry enterprises whose direct problem is producing products for the people. Plants and associations not specializing in this are becoming more actively engaged in the production of goods. In 1984, commerce will receive from the Minpribor (not counting watches and jewelry) over 18 percent more consumer goods than in 1983.

In 1984 our sector plans to manufacture over 45 kinds of consumer goods.

In the three years of the five-year plan period, production for some individual items even exceeded the demand. Therefore, in 1984, the output of wristwatches will be reduced somewhat, but the production of alarm clocks will increase.

It is not enough to simply release technically complicated products beyond the gates of the plant and even get them to the stores. The success of the goods is determined greatly by a developed network of customer services and repairs. A great amount of work remains to be done on this with regional domestic and public service administrations. There is already some experience in equipping posts for refilling ball-point ampules and for repairing watches, but we understand that this is only the beginning of a large and necessary work.

There are many organizational and technical difficulties in solving the problems faced by the sector. To overcome them requires further strengthening of discipline and responsibility in all links of production and management. An industrial sector "ASU-pribor" helps greatly in this.

Regrettably, cases of infringement of contract obligations on deliveries are not eliminated fully. Overconsumption of materials is permitted at a number of enterprises. There are still lagging collectives along with leading collectives.

The Minpribor Board reacts efficiently to all cases of infringement in the progress of fulfilling plans and obligations. Greater intensification of production became the main course for all enterprises and associations.

Intensification of production and development in the sector demand the broadest complex of measures to implement the target programs in the sector for the reequipment of production facilities, the introduction of industrial robots, manipulators and robot equipment complexes, a wide changeover to efficient forms of the scientific organization of labor, and the efficient utilization of materials and power resources.

This year we must increase by 1.5 times the output of industrial robots and manipulators which, without doubt, will have a large economic effect. We plan to mechanize and automate about 100 shops and sections, with 20 of them being comprehensively robotized.

We could cite many other numbers that are characteristic of those organizational-technological measures being carried out in our sector for the further reequipment of production facilities. But it is not only a matter of numbers.

In intensifying production, work is important directly on the site and an investment is also important in the reequipment in the instrument-making sector of all enterprises that produce a specific yield to the national economy. Here, as shown by experience, much depends on whether this enterprise is ready to be changed over to intensive roads of development or are its managers working in the old ways, thinking of immediate success and paying little attention to the future.

The Orel "Prompribor" Production Association has been famous in our sector for many years. It supplied its manufactured products to the fuel-power and agricultural-industrial sectors. Its managers never turn to higher organizations for trifles and cope successfully with all their problems. Moreover, specialists of the association help other Orel enterprises. The "Prompribor" Production Association became the regional center of robotization.

The situation is different at the Kazan' "Teplokontrol'" Production Association. For several years in a row it was among the leading ones; then it gradually yielded its position, and became one of the lagging ones.

Why did this happen? In its time the association's managers were carried away by immediate problems, striving to fulfill and overfulfill planned tasks without looking to the future -- what products will they have to produce in the future. They did not envision future radical reequipment of production which led to great difficulties. Now the "Teplokontrol'" has improved its work noticeably, but for this, of course, it required additional resources and the help of a number of enterprises and organizations for the reequipment. At present, work is being done on producing a comprehensively mechanized and automated production facility for manufacturing many products, with a consequent changeover to a new level -- to flexible automated production (GAP). The creation of GAP-assembly of manometers at the Kazan' "Teplokontrol'" Production Association is planned for 1985. We have no doubt that this association will again be among the leading ones in the sector.

The ministry made a pretty good start in the current year of the five-year plan period. The tasks of the first [illegible]ter for basic technical-economic indicators have been fulfilled and [illegible]ulfilled. As compared to the same period of last year, labor productivity increased by 8 percent instead of by 6.7 percent according to plan. Necessary measures are being taken on the absolute fulfillment of socialist obligations and reducing production costs by an additional 0.5 percent.

Production intensification is a comprehensive and complicated multiplan problem. Its solution is especially urgent now, in the closing period of the 11th Five-Year Plan, with its responsible problems on implementing the most important decrees of the 26th party congress and the following Plenums of the Central Committee of our party.

2291
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BELORUSSIAN INSTITUTE ESTABLISHES FMS, ROBOTICS DEPARTMENT

Minsk SOVETSKAYA BELORUSSIYA in Russian 18 Oct 83 p 2

[Article by Professor G. Khutskiy, doctor of Technical Sciences, dean, Department of Robots and Robot Equipment Systems, Belorussian Polytechnical Institute: "In the VUZ Orbit: Robot 'Bosses'"]

[Text] The country's first Department of Robots and Robot Equipment Systems was opened this February at Belorussian Polytechnical Institute. Its graduates will be faced with developing and operating automated shops which are practically unmanned.

Such shops have been created on the basis of the concept of flexible manufacturing systems (GAP [FMS]) now in place. It may be said that the FMS is in fact the automated shop the June (1983) CPSU Central Committee Plenum indicated it is necessary to introduce widely.

We have recently observed a break-down of flow-line and large-series mass production and a changeover to series and small-series production, even in such branches as the automotive industry. About 80 percent of all items are being manufactured on a series or small-series basis.

Over the past 20-25 years, the products list of items being produced in our country has grown at least 10-fold and now comprises many millions of items. This trend is particularly characteristic of Belorussian industry, with its outstripping rates of development of machinebuilding, radio engineering, electronics and instrument-making. It is for precisely these branches that small-series production, with frequent order changes, that is, regular product updating, is typical. Mechanizing, and especially automating, such enterprises is extremely complicated, due to the frequent production changeovers or adjustments in individual links from one type of work to another.

The traditional "rigid" automation equipment has become unsuitable, and so the problem of developing flexible automated production facilities based on technological equipment with programmed control and industrial robots. World experience shows that an FMS reduces the workforce approximately five-fold, increases the productivity of each unit of equipment up to 300 percent, improved product quality and reliability, and permits small-series production and the manufacture of small lots of items, using flow-line production methods, to fill individual orders.

Moreover, the introduction of FMS's will ensure an increase in the shift index and equipment load, stabilization of output specifications and the elimination of difficult, monotonous, fatiguing manual labor and labor under hazardous conditions.

The FMS includes a complex of basic and auxiliary technological equipment, a transport and storage system, a complex of control devices, programs, software, data and organizational support. Particular note should be made of the programs and software, which are the most important FMS component. The software includes models, methods and algorithms for solving control tasks at all levels. FMS programs are built on their base.

A technical base now exists for developing FMS's: machine tools with numerical programmed control, industrial robots, control and microprocessor equipment, automated control systems and automated planning systems. There is a base, but broad scope to this work will depend to an increasing degree on personnel training. That is why the creation of a Department of Robots and Robot Equipment Systems is so urgent. The department will train engineers in four specialties: robot equipment systems, the automation and comprehensive mechanization of machinebuilding, electric drives and the automation of industrial devices (specializing in programmed-control systems for industrial devices and robot equipment complexes) and hydro-pneumatic automata and hydraulic drives (specializing in hydropneumatic drive systems for automatic manipulators). We are preparing to open up one more specialty, that of automated planning systems.

The specialties are thus chosen so as to train engineers to develop and operate all the main FMS links. The department's academic and scientific work is being led by the Robot Equipment and Machinebuilding Automation department and the Electrical Equipment and Industrial Devices Automation department. We plan to set up a specialized department for flexible automated production facilities and subsequently a department of robot hydropneumatic drives. A department of FMS software must be organized in the future.

From the very start of its work, the department has had very close ties with production, and a branch of the Robot Equipment and Machinebuilding Automation department will be created very soon at the Scientific Production Instrument-Making Association imeni Lenin.

Training personnel for the new occupation is being combined in our department with strenuous scientific research. A branch Industrial Robots laboratory has been created. The collectives of the specialized departments are doing some very promising research. The physics department attached to our department is beginning research on robot equipment systems with industrial vision (second-generation robots) and robots with artificial intelligence, which possess the ability to adapt to outside conditions (third-generation).

The department has a skilled teacher staff available to it. It is comprised of about 50 doctors and candidates of science. Our department is the first robot equipment department in the country. It is just beginning to train personnel who are needed now in large numbers. The department is therefore creating a center for retraining engineers with a higher education. This center will train FMS specialists off the job for six months at a department of robot equipment and machinebuilding automation branch right at the enterprise.

The department has been in existence for half a year, and new tasks and problems which must be resolved quickly have been revealed. They include, first of all, organizing branches of the specialized departments at enterprises, creating a branch robot equipment scientific research laboratory and creating a study-science-production association. We are also faced with rapidly creating new laboratories (Robot Data Devices, Control System Electronic Devices, Robot Electric Drives, and others).

The CPSU Central Committee and USSR Council of Ministers decree "On Steps to Accelerate Scientific-Technical Progress in the National Economy" places particular demands on the department collective and the entire institute by advancing as one of the primary work directions the extensive automation "of technological processes on the basis of automated machine tools, machines, machinery, standardized equipment modules, robot equipment complexes and computer equipment."

11052
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AGGREGATED MACHINING SYSTEMS ON STREAM IN BELORUSSIAN PLANTS

Kiev RABOCHAYA GAZETA in Russian 18 Feb 84 p 2

[Article by S. Zhdanov, machinebuilding institute instructor and leader of the student Mechanizing Manual Jobs and Robot Building design bureau, Voroshilovgrad: "Robots 'On Staff'"]

[Text] The collective at the Impuls scientific-production association in Severodonetsk has taken on higher obligations for the current year. Among other important points, they include: ensure above-plan growth in labor productivity of one percent and lower output net cost by half a percent. One reserve which will doubtless enable it to keep its word is scientific-technical progress. The proportion of mechanization in the association increases year by year. And several auxiliary operations will be operated in the near future. Several manipulators are to be installed to load and unload output. This will not only raise labor productivity, but it will also lower output net cost by 1.6 million rubles. Some 540 workers will hypothetically be freed for other jobs and labor will be mechanized at 130 work stations. Association party committee secretary B. Mikiton thinks "production robotization is very profitable."

The same opinion of industrial manipulators is held at the Krasnoluchskiy machinebuilding plant. Last year, several sectors were mechanized here. NPC machine tools were installed, necessitating robot "tie-ins." And they tried to do it in such a way that the technological cycle would be precise while one robot serviced several machine tools. It is common knowledge that machinery operates most efficiently in "teams" of this type.

A sector producing chutes and scraper conveyors has been automated. This output is produced only on fully mechanized lines which include manipulators. With practically the same number of workers, this modernization has permitted constant growth in enterprise capacity, 25 percent in recent years.

Last year, the Krasnoluchskiy machinebuilding plant produced nearly a million rubles worth of above-plan output. This year, it has obligated itself to provide its above-plan increase in labor productivity through production intensification.

The development of flexible automated production facilities (GAP [FMS: flexible manufacturing systems]), unique systems capable not only of taking on complex, monotonous jobs, but also, when necessary, of rapid readjustment to a new products list, is underway in Krasnyy Luch.

Which is why a robot has been installed in the consumer goods sector at the Azot association in Severodonetsk. It takes the "diplomat" cover off a special machine tool. The lock clicks, it takes the processed parts, sets them aside, and picks up the next ones. Doubtless, a monotonous, uninteresting job. And it's a good thing two people were (hypothetically) freed for other work because this process was automated.

"However, we should also like to see an economic impact," emphasizes B. N. Lishchina, the association director.

It could be increased: the development cost 46,000 rubles and 15,000 was paid for manufacture of the robot. Expensive. So the question of creating complexes is before us. The investment could then be recompensed faster.

The return on an automated sector at the tool association imeni Rudye is also low. Its development followed all the rules: closed cycle, programmed control. However, the expensive computer equipment now stands idle, as prompt attention was not paid to personnel for the sector. Unfortunately, the programmers did not know the production technology and the technologists, in turn, were not familiar with the principles of mathematical programming. Hence, difficulties.

Recently, 240 mechanized lines and upwards of 40 automated lines have been put into operation in city industry under a target comprehensive program. Each year, the number of people working under unfavorable conditions decreases. However, there are still quite a few shops which could do with putting robots "on staff," for example, the Voroshilovgrad Foundry and Machine Shop. The sectors are dry and dusty and the workers, many of whom are women, are doing monotonous work such as assembling, molding and cutting threads for radiators.

The institute has suggested installing automatic manipulators here. But the director, B. F. Rakov, and the chief engineer, P. V. Sergiyenko, are still thinking about it. First, there are no skilled personnel, second, it's kind of expensive....

In order to make introducing such equipment easier, we need a coordination center which could be consulted, advise and help develop it. One could be created at our institute. Be even that would not be enough. In Zaporozh'ye and Nikolayev, such centers have essentially become unique robot "plants." True, they do not have their own machine tools or production space or metal. Subassemblies and parts are manufactured by all the enterprises cooperatively. It's more to their advantage.

We also need to get involved in robotization because the level of enterprise mechanization in Voroshilovgrad is considerably lower that in, say, Zaporozh'ye Oblast. And during the 11th Five-Year Plan to date, the rates of reduction in the proportion of manual labor have been just one percent.

Dozens of Voroshilovgrad area labor collectives are engaged in socialist competition to increase labor productivity by one percent and lower net cost by half a percent as against the plan. They are trying to use all reserves as fully as possible. One such reserve is unquestionably comprehensive production automation. Robots must also be put to work.

11052
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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 658.51.011.56

PRODUCTIVITY OF NC MACHINING SYSTEMS SURVEYED

Moscow MASHINOSTROITEL' in Russian No 12, Dec 83 pp 9-10

[Article by Candidate of Technical Sciences A. A. Panov, chairman of the "Industrial Robots and Manipulators" commission of the VSNTO (All-Union Scientific-Technical Society) Committee for Automating and Mechanizing Production Processes, under the heading "Production Mechanization and Automation": "Perfecting Machining Automation"]

[Text] Machinebuilding enterprises and organizations have accumulated a certain amount of experience in automating labor-intensive, difficult jobs in machining through the development of flexible manufacturing complexes (systems): "automatic manipulators - NPC machine tools." More than 30 automatic manipulator (AM) programmed-control models have been developed to service metal-cutting machine tools. During the 10th Five-Year Plan, enterprises of the Ministry of Machine Tool and Tool Building Industry produced 205 such manipulators, 20 of which became part of automated complexes.

When determining the set of equipment suitable for operation in flexible manufacturing systems, the degree of NPC machine-tool automation was chosen as the main criterion. We first began developing complexes for working rotating-body parts (shafts, flanges, bushings and others) and simple-shaped flat and body parts. Selected for inclusion in flexible manufacturing systems were: models 16K20T1 and 16K20F3, series-produced at the Krasnyy proletariy machine-tool manufacturing plant imeni A. I. Yefremov; models 1B732F3 and 1740F3, produced at the machine-tool manufacturing plant imeni S. Ordzhonikidze; models 1716 and 1725MF3, produced at the Sasovskiy machine-tool production association; models 16K30F3 and 111756F3, produced at the Ryazan machine-tool production association, and others. The machine tools were modernized for use in these complexes, to wit, the clamping of parts, electrical automatic equipment and other subassemblies were automated.

Production complexes based on the 16K20F3 machine tool and the SM80Ts48.11 automatic manipulator, for machining shafts 20-125 mm in diameter and 160-750 mm long, and complexes based on the 1P756F2 machine tool and the SM80Ts48.11 manipulator, for machining cartridge-type parts up to 630 mm in diameter, have been in use for a long time under industrial conditions. The Dinamo electrical machinebuilding plant imeni S. M. Kirov in Moscow, is introducing a production complex for machining electric motor shafts weighing up to 160 kg; it is to consist

of a model MR179 centering-milling machine, two model 1B732F3U3 NPC lathes, a model UM160F2 overhead (gantry) manipulator and auxiliary equipment. Complexes serviced by models PR-5, Tsiklon-3, Tsiklon-5, Universal-5, PR-10I, KM10Ts4201 and Brig-10 AM's with a telescopic horizontal arm and cantilever lift mechanism and models SM40Ts40.11 and MAN-63S AM's, also with a horizontal telescoping arm, but employing a lift carriage, are in use at machinebuilding enterprises in a number of branches.

Specialized AM's, which most fully solve specific technological problems, are more reliable, easier to repair, and cheaper to manufacture and operate. Gantry-type AM's are preferable in terms of space occupied, ease of maintenance and convenience of equipment operation observation.

Experience has shown that current expenditures are reduced when automated complexes are introduced at the expense of an increase in capital investment, which can turn out to be quite substantial. In this regard, output net cost is lowered until such time as the complexes are saturated with automata. If investments are increased further, the annual depreciation deductions from the cost of the automata rise faster than the savings under other items of net cost.

The choice of flexible manufacturing system (sector, complex, shop) in machining with a view towards meeting the demand for rapid adjustability is determined by the parts products list and size of the lots. We proceed from the fact that greater opportunities for the use of flexible manufacturing systems are ensured as the number of different parts decreases and the size of the lots increases.

NPC machine tools can be quickly adjusted to manufacture the most diverse parts. Their main advantages, great flexibility and rapid adjustment, are used most effectively in the manufacture of templates and dies. However, the productivity of such machine tools is quite a bit lower than that of automatic lines.

The introduction of NPC machine tools is the first stage in increasing production automation. It eases the labor of the machine tool operator and increases his prestige, and the machine-tool control system meets the demand for improving the efficiency of an existing production facility.

Processing centers are characterized by the inclusion of systems for replacing tools and blanks, measuring systems and systems for diagnosing the status of the equipment. The next stage is the development of more flexible and improved modular systems in nearly all machine-tool groups, especially in milling and boring processing centers, providing various levels of automation of the control of machine tools and their servicing. As additional automation is introduced (for example, automatic measuring, tool stability monitoring, tool breakage detection, and others), an opportunity is created for fully automating the processing of parts. This type of processing center is the basis for developing flexible manufacturing systems.

Another direction in the development of these systems is the creation of adjustable flow lines or automatic lines, in which the individual processing positions can be separated. The flexibility and speed of adjustment are provided by the use of highly automated, computer-controlled processing centers. Isolated interruptions in the operation of the line can be compensated for by building in

auxiliary storage units. The opportunity for interfacing processing centers with various types of loading and transport devices is quite important. This ensures their rapid adjustment when changing types of parts, the possibility of making changes in their design and of updating them, as well as the chance to introduce new type-sizes of products. The use of NPC machine tools ensures the relatively rapid replacement of processing programs, production flexibility and improved labor productivity.

In the area of mass production, the use of such systems is very limited, which is compensated for by the use of automatic lines, the highest level of development of flow-line production, which ensure high productivity. Automatic lines are generally based on highly productive unit machine tools designed especially for specific processing conditions. Parts are processed and transported automatically. Parts transport by floor-model or overhead conveyor follows the sequence of processing positions, so the linear principle is prevalent in automatic lines. However, in order to meet the special requirements of a customer who is not in a position, when the technical assignment is issued, to make a final determination as to the number of processing variants, a flexible manufacturing system, operating in parallel with it, is often installed.

The flexible production module, an element in the flexible manufacturing system, includes one or several NPC metal-cutting machine tools, an industrial robot, a storage or warehouse area, loading and clamping positions. A module often consists of only a processing center and an industrial robot for loading parts. The robot can be built into the machine tool or separate, between the machine tool and the storage area, in which case it operates both following a rigid cycle and following a freely changing program together with the replacable gripping devices. The robot takes a part from the storage and loads it onto the machine tool, where it is then clamped and worked (done through several repositionings and clampings, in many instances). The robot then removes the part from the machine tool and transfers it to a storage area or other machine tool. The storage design is determined by the type of industrial robot and the type of part. It is generally loaded and unloaded manually. The parts are transported between production modules primarily by stacker.

The number of spindles and functions a processing center must be equipped with depends on the production task. In a majority of cases, the reference is to multiple-function machine tools on which all or nearly all the different working operations are performed. Such machine tools must therefore have a very large tool magazine, with the tools being interchanged automatically, as a rule. In a number of instances, small, multiple-spindle drill chucks are installed in the tool magazines to perform the most frequently repeated drilling operations, thus reducing primary and auxiliary time and creating opportunities for multiple machine-tool servicing. In a majority of instances, the production module is controlled by a mini-computer to which the peripherals of the module are subordinated, or even by a higher-level computer.

Production modules must basically be used when the existing production structure, parts products list and number of parts in the lots do not permit the use of a linear workstation arrangement, and when it is also desireable to reduce the number of servicing personnel linking production cycles, and to raise the machine-tool use factor and level of multiple machine-tool servicing. Moreover, their use permits freeing people from production spheres hazardous to health or life.

The basic sphere of application of flexible adjustable manufacturing systems is types of production in which the tasks involve complete processing of individual parts in very small lots. In recent years, the concept of a flexible manufacturing system has acquired a very definite content: NPC metal-cutting machine tools operate independently of each other; there is a free flow of parts through the transport and loading systems; control and data systems fully coordinate the functions of the metal-cutting machine tools, transport and loading devices. Flexible manufacturing systems can include varying numbers of machine tools and processing centers (mills, drills, lathes and multiple-spindle machines).

Flexible production modules and flexible manufacturing systems are also used to process shafts and such typical machine-tool manufacturing parts as bedplates, transmission housings, tables and crossbars.

Two of the main advantages of flexible systems are revealed when groups of homogeneous parts are processed. In a single-stage system, each machine tool has a definite sequence of operations and the parts are completely processed. Thanks to its universality, such a system possesses great flexibility. A multistage system anticipates dividing the work within the system. Thus, upon completion of a certain processing sequence, the part goes to a central storage area or to the next group of machine tools for subsequent processing or to a temporary storage device (an additional system is used).

A combined system, with complete and supplemental processing positions, is used less often than single-stage systems. However, it permits in some measure overcoming the difficulties connected with equipment load in the multistage system thanks to the use of processing centers and unit machine tools. In addition to the processing position, they anticipate the use of an auxiliary position, blank storage facility, tool storage and measuring position. At the processing position are the parts and tools storage devices, in the form of buffers. All the system elements are centrally controlled by higher-level computer, which is linked to numerous processors. The material feed systems perform the tasks of transport, storage and loading. Floor-model conveyor belts, driven roller conveyors and induction-drive carts are used as transport systems. The transport systems are computer-controlled. Parts are loaded and unloaded between the machine tool and transport system by industrial robot or pallet-switching device.

Interoperational storage areas balance unevenness in technological operations and ensure operation of the production in the event any particular element malfunctions. However, they are always associated with intercepting the flow of incoming blanks, necessitate additional manipulation operations (stockpiling, selection and others), occupy work space, and use energy. The necessity therefore arises for a technical resolution which will ensure maximum use of storage capacity.

The following principles must be observed when choosing interoperational storage equipment, operational automatic manipulators and warehousing equipment:

-- automatic manipulator and storage facility equipment design is inseparable from production process planning;

-- the level of technological processing automation corresponds to the levels of management and of operational and interoperational automatic manipulation;

-- the power of interoperational and operational automatic manipulators and

the power of the production sectors correspond to the level of technology, organization and management;

-- manipulation operations and equipment are reduced to a minimum.

At present, automatic interoperational manipulation and warehousing equipment are used basically for automatic lines (rigid automation). One way of modifying this equipment for use in a flexible automated manufacturing facility is to switch it to digital programmed control. Special "flexibly" programmable automated manipulation sector designs are being introduced in automated production sectors. The machine tools and loading devices can be linked individually, in view of the diversity of the equipment being serviced. Thus, the basic production module in automated sectors must be the "equipment - automatic manipulator" technological complex or the "group of equipment - automatic manipulators" complex in the case of group servicing. When complexes are combined, the AM and system receiving positions must be standardized: transport and packaging satellites, control system output elements.

As operating experience has shown, an automated AM-equipped complex saves an average of 1.2 to 1.5 man-shifts per day, or about three man-shifts for two-shift operation, and labor productivity is 26-40 percent higher. When AM's are used in groups, labor productivity is increased 1.5- to three-fold, servicing expenditures decrease, and production smoothness and product quality improve.

Given proper selection of the automata, combining complexes in a sector permits a 1.5- to 2.5-fold reduction in the number of workers (one worker-operator services up to 3-5 machine tools) and significantly increases labor productivity.

11052
CSO: 1823/214

GUIDELINES FOR OPTIMIZATION OF ROBOTIZED MACHINING CELLS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 1, Jan 84 pp 23-24

[Article by Candidate of Technical Sciences A. Ya. Baryshnikov and Engineer S. V. Il'in]

[Text] Robot engineering complexes (RTK) based on NC [Numeric Controlled] machine tools are[*] becoming increasingly more widespread in machinebuilding and metal processing. What contributes to this? First of all, the use of RTKs ensures a 10-20 percent increase of labor productivity over that of NC machine tool sections, as a result of reduced costs of manual labor for performance of auxiliary operations (feeding and setting up of blanks, removal and receipt of machined parts, replacement of the cutting tool, disposal of chips, etc.), and also expansion of the service zone and number of machine tools and freeing of machine tool operators.

Production output is increasing thanks to the rise in labor productivity and a 20-30 percent increase of the shift-work coefficient of RTK operations with simultaneous improvement of equipment loading. This creates real possibilities of raising the load coefficient to 0.85-0.95 percent.

Then the need for special cadres to maintain the RTK's manipulators and training costs for them are reduced. As the work experience of several industrial enterprises shows, maintenance of the RTK may be entrusted to personnel involved with preparation of production on NC machine tools, their adjustment, repair and preventive maintenance by compaction of the work day.

Finally, prerequisites are being developed and the possibilities of comprehensive automation of mechanical machining processes without the intervention of maintenance personnel are expanding.

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[*] Baryshnikov, A. Ya. "Effective Use of Automatic Manipulators for Mechanical Machining of Parts in Serial Production" - "Production Mechanization and Automation", 1981, No 2, pp 20-21.

NC machine tools, especially with automatic tool replacement (machining centers - OTs), possess a high degree of automated control of the machining process, ensure production "flexibility", which is created thanks to the small consumption of time and means for resetting equipment when changing over from production of one type of part to another. Here, the functions of the automatic manipulators (AM) are simple. These amount to installation of the blank on the machine tool (attachment), its removal after machining, and transfer to the next operation. Consequently, the structure of the AM for maintenance of the machining center is being simplified, the reliability of the RTK is increasing, and the cost is decreasing. This opens possibilities for creation of complex automatic sections of RTKs on a computer-controlled NC machine tool base.

Improvement of working conditions in view of the sharp reduction or complete elimination of manual labor increases the creative element in the work of maintenance personnel. Two forms of labor organization are in practice.

With the first, the RTK is maintained by a highly qualified setter-up (5th-6th class) and operator (2nd-3rd class). The setter-up sets up and adjusts the RTK (machine tool, AM), fits it with tools and resets the system. The operator sets up the loaders with blanks, places the machined parts in packages, oversees the section's work, controls the quality of part machining, conducts organizational maintenance of the RTK, helps the setter-up eliminate defects, etc. The maintenance norm is 3-4 RTKs for the operator and 6-8 for the setter-up.

Becoming increasingly more common, however, is the second form, with which all functions for maintenance of the RTK are entrusted to the setter-up, and the machine-tool operator is freed. The maintenance norm decreases to 2-4 RTKs. With this form, higher requirements are put on the setter-up's professional training: he must rapidly and accurately eliminate defects not requiring the intervention of special staff. The setter-up must also have a more thorough and broader knowledge of engineering, technology, electronics, economics and production organization, etc., close to the level of an engineer. All this considerably alters the nature of the work itself. A high degree of theoretical training blends harmoniously with the physical work of setting up and maintaining the RTK, which erases the boundary between mental and physical labor and between various categories of production industry personnel (PPP).

The most effective form of production organization is the creation of sections with RTKs on a base of NC machine tools and automatic manipulators. The use of RTK groups allows fuller utilization of the technological, organizational, economic and social possibilities of this equipment.

Let's examine the effective use of RTKs in specific examples.

1. A section was developed with six RTKs, each of which consists of a model LF260MF3 NC machine tool and AM, which changes the cutting tool. The section was designed for the machining of casing parts. A typical steel casing has 20 overall dimensions of 300X200X160 mm and weighs up to 3 kg. The time norm for

completing operations, compared with machining on the LF260F3 machine tool without automatic tool replacement, has not changed. Use of the AM has increased the duration of part of the operation cycle, executed in a continuous automatic regime, to 20 minutes. Owing to this, the service zone has expanded from one to three RTKs, and four machine-tool operators have been freed. The RTK's shift-work coefficient increased to 1.6 with a load coefficient of 0.95. The annual economic effect is 16,000 rubles. Labor productivity almost tripled.

2. A section was organized with three RTKs, each of which consists of a machining center and model "Universal-15M" AM. The machining center was developed on the base of a horizontal boring machine without a rear vertical stand. The machining center cost 100,000 rubles. The section supported machining of four types of aluminum-alloy casing parts. The parts' overall dimensions do not exceed 300 mm in any measure, and weigh 5 kg. The use of RTKs has reduced the machine-tool processing capacity from 4.25 to 4 machine-tool hours; the shift-work coefficient increased from 1.75 to 1.86, and the load coefficient from 0.87 to 0.95, and two 3rd class machine-tool operators were freed. Production output increased 10 percent. The annual economic effect was 11,300 rubles. It will pay for itself in 5 years. One 6th class setter-up maintains the section.

3. RTKs with a model 1A341Ts cyclic program control machine tool and RF204M industrial robot for turning of "disk" class parts made of non-ferrous alloys and weighing up to 1.5 kg were introduced. Use of RTKs compared with the 1A341Ts base machine tool reduced the production unit's machine-tool capacity from 1.53 to 1.77 and shift production from 200 to 250 parts, and freed two workers. The annual economic effect of using one RTK was 1,500 rubles.

4. A technical economic analysis, performed in the technical design phase, of a section of 20 NC machine tools (12 model LF260MF3 units, 5 model 6520F3 units and 3 model 6R13F3 units) and 7 "Universal-15MK" automatic manipulators for the machining of 73 types of small casing parts with a total annual program output of 130,000 units shows that machine-tool capacity decreases from 199,720 to 72,810 machine-tool hours, and the number of machine-tool operators decreases by 56, compared with machining on standard machine tools. The magnitude of the expected economic effect should be 124,000 rubles and costs should be recovered in 5 years.

It is proposed to entrust the following functions to the AM: transport and unloading of blanks onto machine tools, tool replacement in the machining process, removal of machined parts. The operators oversee the equipment's operation, clear away shavings and dust, control production quality, etc.

The annual economic effect ($Э_г$) [E_g] of using the general form of RTKs is defined by the formula

$$Э_г = \Delta C - E_н K, \qquad (1)$$

where ΔC is the saving from reduction of the cost of the annual volume of parts production. It may be calculated by

$$\Delta C = \Delta C_{v} \frac{F_{э} \eta_{1} Q}{t_{2}} + C_{f}\left(\frac{\eta_{2}}{\eta_{1}} \frac{t_{1}}{t_{2}} - 1\right) + \Pi_{c} - C_{эр}. \qquad (2)$$

where ΔC_{v} is the saving of arbitrarily variable expenses in production cost during use of the RTK, calculated with regard to payments from the public use funds, rubles; C_f is the arbitrarily constant part of production cost, rubles; $F_э$ [F_e] is the effective time fund for the RTK's operation during a single-shift regime, hours; Q is the number of equipment units contained in the RTK; η_1, η_2 are the shift-work coefficients before and after introduction of the RTK; t_1 and t_2 are the machine-tool capacity of the production unit, machine-tool hours; [Γ_s] Π_c is the saving dependent upon the social consequences of using the RTK, rubles (factors ensuring this saving are the reduction in worker demand and turnover of cadres, decrease of injuries and absenteeism, etc.); $C_{эр}$ [S_{er}] are maintenance and operating costs of the AM and nonstandard equipment and fittings contained in the RTK; $E_н = 0.15$ [E_n] is the effectiveness standard of capital outlays; K is additional capital outlays caused by use of the RTK, including the cost of training the cadres and satisfying housing, social and other needs.

The economic effect of introducing RTKs was calculated according to the proposed procedure for the above-mentioned examples. The results of the calculation are presented in the table.

(1) Состав РТК	(3) Число РТК	(4) База для сравнения	(5) Станкоемкость, станко-ч		(8) Коэффициент сменности		(9) Экономия условно-переменной части ΔC_v	(10) Условно-постоянная часть ее себестоимости C_f, руб.	(11) Дополнительные капитальные вложения (—) экономия K, руб	(12) Годовой экономический эффект $Э_г$, руб
			(6) До внедрения t_1	(7) После внедрения t_2	До внедрения ν_1	После внедрения ν_2				
(2) ЛФ260Ф3+АМ	3	ЛФ260Ф3	0.4	0.4	1.50	1.70	0.4623	10400	−27000	16 000
ОЦ+«Универсал-15М»	3	ОЦ	4.25	4.00	1.75	1.86	2.2360	42085	+18000	11 300
1А341Ц+РФ204М	1	1А341Ц	0.03	0.028	1.53	1.77	0.0039	1400	—4600	1 500

Key:
1. RTK composition
2. LF260F3 + AM
   OTs [machining center] + "Universal-15M"
   1A341Ts + RF204M
3. Number of RTKs
4. Comparison base
5. Machine-tool capacity, machine-tool hours
6. Before introduction
7. After introduction
8. Shift-work coefficient
9. Saving of arbitrarily variable part
10. Arbitrarily constant part of its price, rubles
11. Additional capital outlays (-) saving, rubles
12. Annual economic effect E_g, rubles

Formula (1) and the given tables show that the economic effect of introducing RTKs depends on the price structure of the machined parts, increase of machining productivity and the shift-work coefficient, RTK cost, its operating reliability and improvement of work conditions during use of the RTK.

To further increase the effective utilization of RTKs on a NC machine-tool base it is necessary:

to raise the level of production organization, primarily providing the fullest load, in view of this, expanding the variety of parts machined on RTKs with regard to increasing their productivity;

to expand the service zone of the robot or manipulator;

to improve the maintenance of RTKs, for which it is advisable to create at enterprises and production associations special structural subdivisions, called on to perform the functions of technical preparation at the RTK, and comprehensive organization of their maintenance;

to reduce the cost of AMs and the NC equipment serviced by them;

to devote greater attention to providing information on the problem of robotized production on NC machine tools and applying the best practice of RTK utilization;

to improve the procedure of defining the socio-economic effect of RTKs and development of performance standards, allowing more successful economic evaluation of the social consequences of introducing RTKs.

12421
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BETTER ELECTRONICS, MANAGEMENT TECHNIQUES NEEDED FOR FMS DEVELOPMENT

Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 84 p 14

[Article by S. Smirnov, chief manufacturing engineer of VPTIElekto [All-Union Planning and Design Institute of Electrical Equipment Production Technology]: "Prospects for the Development of Flexible Production Facilities"]

[Text] The development of flexible automated production facilities (GAP) is becoming more and more urgent under current conditions.

What is the objective of this development? Fundamental increase of labor productivity with simultaneous marked reduction of the number of servicing personnel.

Fundamentally new methods and hardware are used in GAP. Such production facilities are based on automated equipment with computer numerical control, automatic manipulators and trans-manipulators with microprocessor programmed control, automated and robotized transfer-storage, accumulation, support, inspection, and servicing systems with control from central processor and modular computer complexes. All this is combined in the GAP based on group and "typical" technology for machining a "family" of technologically homogeneous parts such as shafts, housings, flanges, sleeves, gears, levers, and other labor-intensive articles.

Increase of the shift utilization index to 2.5-2.8, increase of the equipment utilization factor to 0.85-0.9, and marked increase of productivity make the GAP technical and economic characteristics for small-series and intermediate-series production of the articles close to the mass production characteristics. The number of factory personnel decreases by a factor of six or more, the number of machine tools decreases by a factor of 6-7, the production area decreases by a factor of 4-5, and the cost decreases significantly.

VPTIElektro (the lead institute in this field) has initiated a program of studies in this direction. As a result of the use of full automation and robotization we expect to completely eliminate by the end of the 90s manual labor in all the technological processes and raise labor productivity in the electro-technical industry by at least a factor of three.

We are improving the existing enterprises in several directions, the primary ones being the following:

automation of casting production with the use of automatic molding-pouring-expulsion lines and robotized pressure casting facilities;

automation of forging and stamping production facilities with the creation of departments for centralized blank preparation;

full mechanization and automation of the machining technology with the use of CNC equipment, robot manipulators, robotized storage systems, and control computer equipment.

In addition the plating and painting facilities and the processing of conventional and thermosetting plastics are being automated. The loading-unloading and transfer-storage operations are being mechanized and automated by creating robotized storage complexes and automating the transfer and stocking system.

Minelektrotekhprom [Ministry of the Electrotechnical Industry] will develop about 30 industrial robot models, including second-generation adaptive units and third-generation units with artificial intelligence. By the end of the next decade a thousand such robots will be produced in the USSR each year. Half of them will be delivered together with technological equipment, primarily for automating electrical welding and plasma and electrothermal treatment operations.

Of all the industrial robots that will enter operation in the factories of our industry in the course of the next 15 years, 70 percent will operate in flexible automated production facilities, the remainder will operate in automated technological complexes. Their introduction requires the fabrication of a considerable number of special units, pararobotic and tooling equipment, and various inspection and measuring instruments. Both Soviet and world experience shows that the cost of the support equipment and tooling varies from 40 to 100 percent of the cost of the robot itself. Therefore it is important to carefully examine the measures relating to increase of the capacity for the production of pararobotic and tooling equipment.

According to Minelektrotekhprom the expenditures on fabrication of the support equipment alone in 1985 will be 7 million rubles, and within 15 years the annual cost will be ten times higher. Is this expensive? No, not if we consider that according to the estimates of economists the implementation of these measures will make it possible to reduce the labor force in the industry by 1,500 workers in the coming 5-year period, in the 12th Five-Year Plan there will be 13,000 fewer workers, and in the 90s the work force will be smaller by 97,000 workers.

Much remains to be done for successful development of the GAP. More reliable controllers for the industrial robots and the integrated electric drives are required. Progammable controllers based on microprocessor technology and a whole gamut of various sensors for the robots are necessary for control

of the technological processes. We can resolve these problems only with profound personal involvement and persistent efforts of the Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] specialists.

Considerable effort is also required on the organizational side. Each enterprise manager must consider that it is important to fully utilize the GAP. After all, such production facilities are designed for three-shift operation.

USSR Minvuz [Ministry of Higher Educational Institutions] is already involved in training specialists for the setup and operation of robotic complexes and GAP and in organizing technical service support.

Caption [photo omitted]:

An Automated Department. This is a view of an automated department in the Dnepropetrovsk Electric Locomotive Construction Plant. It is equipped with Soviet-made equipment, CNC machine tools, automated transfer and storage systems controlled from a minicomputer, and automatic control and programming systems. All this has made it possible to improve labor productivity in the department by a factor of 2.5. The annual output of parts of 137 different types has been increased by 20 percent. Thirty machine tool operators have been reassigned and the shop floor area has been sharply reduced. The department was developed with participation of the specialists of Minstankoprom [Ministry of the Machine Tool Industry], Minelektrotekhprom, and Minvuz RSFSR.

9576
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UDC 621.985.06-52:658.527:629.113.001.65.002.2

AUTOMATED FLOOR PANEL STAMPING LINE INSTALLED IN MOSKVICH PLANT

Moscow AVTOMOBIL'NAYA PROMYSHLENNOST' in Russian No 2, Feb 84 pp 35-36

[Article by L. S. Sagatelyan, V. S. Komov and B. S. Romanovskiy, Automobile Plant imeni Leninskiy Komsomol: "Flow-Line Automated Line for Stamping Large Size Parts (Floor Panels of the 'Moskvich' Automobile)"]

[Text] One basic direction of the work of technological and design subdivisions of the Automobile Plant imeni Leninskiy Komsomol is developing the means to automate and mechanize the use of universal presses. One such means is an automated line for manufacturing floor panels. Until recently, this panel, weighing 34 kg was made on five presses with five stamping workers and unloading manually.

The initial material for the floor panels are sheets of metal laid on a lifting table 1 by a overhead crane (Fig. 1). The operator separates the sheets manually and feeds them to sheet loader 2. The latter lubricates them and loads them into the working zone of double-action press 3, where the sheets are stamped. The working stroke of the press is implemented by a contactless sensor installed in the die and is possible only when the part is placed correctly, and device 5 for interoperation loading and unloading is in its initial position. The stamped blank is transferred by mechanical arm 4 from the press to the conveyors of devices 5 and enters simple action press 6. Next the stamping operation is done and the blank moves to the following press, etc. The interoperational transportation from press to press occurs automatically. Laying finished parts into packing boxes is done by special device 8 at the end of the line.

Stamping wastes used in production are also carried to packing boxes by belt conveyor 7, while the unused wastes are carried through hatches in the floor located near the presses and fall onto plate conveyors installed in the basement of the shop.

Two operators monitor the operation of the line.

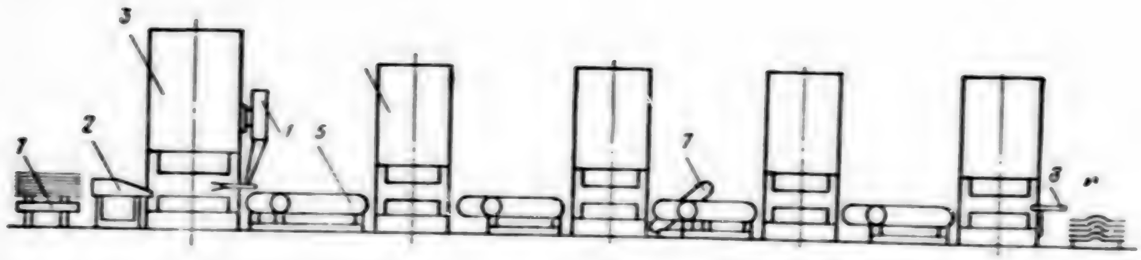

Fig. 1

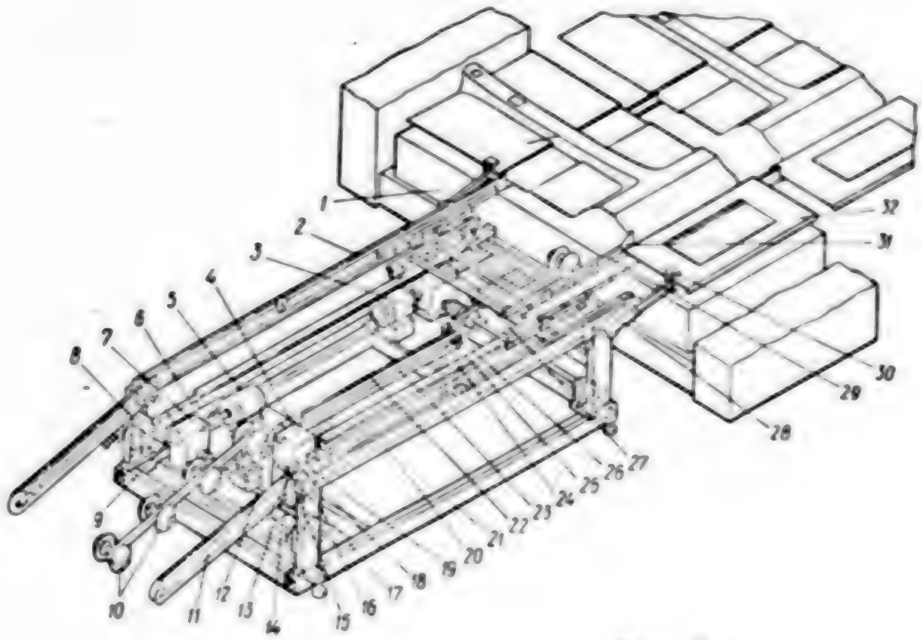

Fig. 2

Specification of line

Dimensions of blank, mm	
width	3070
length	1550
thickness	0.9
Weight of blank, kg	34
Stamping rate, pieces/sec.	15
Productivity, pieces/hour	250
Number of operator-adjusters	5
Dimensions of line in plane, mm	41,000 x 7000

Of special interest, as most original, among devices contained in the line, are the interoperational device (Fig. 2) for loading blanks into the die and unloading them from the working zone of the die.

The device has frame 21 to which beams 20 are attached on posts. Conveyor chains 2 are stretched on the beams by means of sprockets 19. Two slanting extensions 11 with chains stretched on sprockets 18 are installed on hinges coaxiably with sprocket 19. Central driving chain 22 with tension sprocket 25 is mounted on pole 23. Frame 6 is mounted on bonds for guides 24 of carriage 27. Drives of the chain conveyor and of the extension are independent and each is implemented from sprockets 9 and 16, one of which is attached to slow moving reducing worm 7 driven by electric motor 5, while the other sprocket 16 -- is attached to transverse shaft 12, mounted in ball bearings on frame 21. Conveyor chains 2 are also drives. Drive chains 17 for extensions 11 are mounted on driven sprockets 13, attached to same axis with driving sprockets 18 and with freely rotating sprocket 19 of conveyor chains 2. Carriage 27 is driven by pull-rod 3 through cam 26, connected to the central drive chain 22. Leading sprocket 15 of this chain is mounted on the output shaft of clutch-brake 4, driven through the chain by sprocket 14, attached to transverse shaft 12 of the chain drive of extensions 11. The device for laying the blank in die 1 is made in the form of a π -shaped arm from thin sheet metal, attached to carriage 27 together with pushers 29 equipped at the ends with hinged detents 31 with return springs, as well as two plates 30 on the stems of pneumatic cylinders 28, attached to the conveyor beams. The arm is longer than the length of blank 32. Rollers 10 are installed to center the blank on frame 6.

The device is controlled by route switches and operates as follows.

The initial position of the carriage is the extreme rear. Electric motors 5 bring into action chain conveyors 2. The central driving circuit is not switched on in this case because the brake of clutch-brake 4 is off and the feed circuit of the clutch is open. Plates 30, as well as carriage 27, occupy the extreme rear position and do not project beyond the level of conveyor chains 2. Stamped blank 32 gets on the conveyor chains and moves, bending detents 32 to the loading position of the second press. (These detents are returned to the initial position by return springs after the blank passes). The end switch operates in the loading position and the clutch-brake is switched on. Transverse shaft 12 begins to rotate, setting in motion chain 15 and through it central drive chain 22 with cam 26 which, moving forward, moves carriage 27 through pull rod 3 forward along guide 24. Pushers 29 eject the blank from the surface of die 1 onto the extension of the following similar loading and unloading device. Rollers 10, installed along the extension, center the blank. When carriage 27 arrives at its front position, pneumatic cylinders 28 operate, while plates 30 prevent the blank from moving when carriage 27 travels back. Cam 26 on central chain 22 with push rod 3, continuing its movement, moves the tension sprocket and drags carriage 27 back. At the moment that the carriage passes the extreme front position, an instruction is received to lower the lifts in die 1. The carriage arrives at its initial position when clutch-brake 4 operates. In this case, the arms come out from under the blank, while plates 30 insure its accurate positioning in the die. The working stroke of the press begins after the plates move to their initial positions. In case the passage of the blank is held up, the motor is switched off (due to the operation of the end switch) and conveyor chains stop. Chains of extensions 11 continue to move and if

there was a blank on them, it is transported only up to the stopped conveyor chains. After the cause of the delay is eliminated, the operating cycle repeats.

The introduction of the automatic flow-line for stamping panels freed ten basic production workers and increased the productivity of labor. The saving was over 10,000 rubles per year. Moreover, the line provides a constant given rate of stamping.

2291
CSO: 1823/137

CEMA COOPERATION IN DEVELOPMENT, PRODUCTION OF ROBOTS

Moscow EKONOMICHESKAYA GAZETA in Russian No 12, Mar 84 p 20

[Article by Mikhal Pullmann, advisor in the scientific-technical cooperation department of the CEMA Secretariat: "Interaction in Robot Manufacturing"]

[Text] The countries of the socialist community are systematically strengthening their orientation towards resolving the major economic and scientific-technical problems which are of top-priority importance to development of the national economy, towards providing it with material resources and further improving labor productivity in the basic branches of the economy. As was noted in the communique on the 37th meeting of the Council for Economic Mutual Assistance Session, much work is currently being done to implement the large-scale agreements aimed at accelerating technical progress. Such agreements concern foremost resources-conserving equipment, radio-electronics items, chemicals, and industrial robots. It should be stressed that the development of industrial robot equipment is currently considered one of the most important national economic tasks in a majority of the CEMA member-nations.

Cooperation in the field of robot engineering is interbranch and comprehensive in nature. It has been under way for several years now. Bilateral contacts between the NRB [People's Republic of Bulgaria], VNR [Hungarian People's Republic], GDR, USSR, CSSR and other CEMA member-nations were established in this area in the mid-1970's. Close business contacts have been set up among corresponding scientific research and production organizations and the parties have familiarized each other with the national programs for developing robot engineering on a cooperative basis and have coordinated their actions, primarily in the area of scientific-technical development in this area.

The rates of robot-engineering development in CEMA member-nations are illustrated, for example, by these figures. Whereas 250 industrial robots were in use in the USSR in production in 1975, the fleet of robots had reached nearly 6,600 units in 1980. In the NRB, about 230 industrial robot units were being used in production in 1980, and in the GDR, PNR [Polish People's Republic] and CSSR -- approximately 300 each. The fleet of robots in CEMA countries is constantly growing. It is anticipated that 200,000 industrial robots will be in use in CEMA member-nations by 1990, as was noted at the 36th meeting of the Council session. This will be possible thanks to the international division of labor and the organization of specialized, cooperative robot equipment production within the CEMA framework.

Currently, the bulk of the robots are being designed for general machinebuilding technologies, primarily for cold stamping, machining, assembly and welding. The remainder are being used in painting, plating, transporting, casting and other areas.

For example, cooperation between Soviet and Bulgarian specialists was fruitful when a new type of welding robot was developed. This type of robot welder is now undergoing tests in the USSR and NRB. It will find broad application foremost in tractor, agricultural and transport machinebuilding. Cooperation between the Voronezh Experimental Scientific Institute of Forge-Press Machinebuilding (ENIKMASH) and the VUKOV Czechoslovak scientific-production association at Preshov in developing prototypes of various modular robot designs, as well as in developing and introducing the UM-160 industrial robots into production, has been highly effective.

Cooperation is being developed among CEMA member-nations not only in creating industrial robots, but also in developing robotized technological systems based on them (complexes consisting of technological equipment and robots). Experience in introducing these means of mechanization and automation has shown how economically profitable and effective are industrial robots which service, for example, forge presses or metal-cutting machine tools. But in addition to their economic impact, there is also a considerable social impact, as large numbers of workers are liberated from difficult, monotonous labor.

Specialists at the ENIKMASH in Voronezh note that the introduction of one of their industrial robots results in an economic impact averaging 130,000 rubles and that each complex frees 2-3 workers for other jobs. The effectiveness is heightened when a robotized technological sector made up of several pieces of technological equipment and groups of industrial robots is created. A robotized machining sector developed by specialists at the VUKOV association in Czechoslovakia permits an annual savings of 770 tons of nonferrous metals and 20 million krona, and it frees 26 workers for other jobs.

A new stage in CEMA member-nation cooperation in industrial robot engineering has begun in recent years. It is characterized by the broader development of multilateral ties among the fraternal countries. In 1980, an agreement was signed on multilateral scientific-technical cooperation to develop modern industrial robots for various branches of the national economy. Joint work has been done based on this agreement to develop and accelerate the introduction of industrial robots into production. It could be said that this interaction in developing robotized technological systems has helped our countries master about 150 different types of industrial robots as part of complexes with various types of basic technological equipment already.

Another agreement was signed on multilateral international production specialization and cooperation, which has been the basis of a division of labor among CEMA countries in the production of 58 type-sizes of industrial robots. About 75 percent of the robots products list in this agreement are to be produced in 1-3 countries, which will meet the requirements of the remaining parties to the agreement. Reciprocal shipment volumes in the 1981-1985 period will be about 1,500 robot units. We anticipate exporting this equipment foremost from the NRB, PNR and CSSR to the USSR.

At the same time, we are faced, in the course of deepening this cooperation and given the growing demand for industrial robots, with resolving more comprehensively questions of unitization and standardization, questions of changing over to a single concept of the technical development of robot engineering, as well as questions of broad, effective cooperation by countries of the community in this particular area. In order to resolve these tasks, CEMA member-nations have concluded a "General Agreement on Multilateral Cooperation in Developing and Organizing the Specialized, Cooperative Production of Industrial Robots," which was signed in 1982 in the course of the 36th meeting of the CEMA session. Its primary goal is to ensure, on the basis of international division of labor, the better satisfaction of the requirements of our countries for industrial robots and unitized modules, subassemblies and parts for them, as well as auxiliary devices and attachments permitting the layout of robotized technological complexes.

The fraternal countries of socialism have chosen designing modular robots as the main direction in robot manufacturing. This approach permits assembling a robot for any production facility out of a small number of standard modules and subassemblies, as in a child's erector set, rather than developing and producing a new robot each time.

At present, the General Agreement on Industrial Robots is being successfully carried out. Late in 1982, work was completed on the first, and most important, stage in the development of CEMA member-nation cooperation within the framework of this agreement. The work was done within the CMEA Committee for Scientific-Technical Cooperation (KNTS) framework by 12 branch CEMA standing commissions and the international Interelektro economic organization. Their efforts were aimed at determining the specifications for and establishing the demand for industrial robots of various types. On the basis of the results obtained, the KNTS worked out summary specifications for industrial robots, standardized subassemblies and parts for them, as well as a summary top-priority products list for industrial robots and standardized subassemblies and parts for them. Moreover, in this particular stage, in the KNTS framework, existing industrial robot designs being used in various branches of the national economy of our countries and in world robot manufacturing were analyzed and a concept of the technical development of robot engineering when organizing CEMA member-nation interaction in this area was agreed to.

Based on KNTS materials, proposals were developed in 1983 within the framework of the CEMA Standing Commission for Cooperation in Machinebuilding on supplementing the agreements on multilateral scientific-technical cooperation in the area of developing industrial robots and programmed control systems for them. The CEMA Standardization Institute developed a draft "Program for Comprehensive Standardization of Industrial Robot Equipment for 1983-1990."

The next stage in implementing the General Agreement on Robots is associated with concrete scientific research and planning-design work to develop modern, highly reliable industrial robot equipment with a high level of standardization of basic parameters in the component subassemblies and parts of industrial robots. Success in this work will be aided by the accelerated implementation of the program for comprehensive standardization in this area which was approved by CEMA member-nations at the 90th meeting of the CEMA Standing Commission for Cooperation in Machinebuilding (September, 1983).

Scientific-technical progress poses ever newer and ever more complex tasks in the field of robot engineering. We already require automatic units with a high degree of adaptability to production lines, robots capable of completing their own programs and of fixing themselves.

According to forecasts by scientists, the bulk of the fleet will be second-generation robots by 1985, meaning units equipped with various sensors, including mechanical vision. By 1990, the main types of robots will possess microprocessor devices permiting analysis of a situation and the decision-making necessary to carry out production functions entrusted to them. The time is not far off when robots will be developed which will be capable of assembling new robots.

The widespread use of robot equipment will permit a sharp rise in labor productivity and production efficiency and will create qualitatively new working conditions for man and his relationship to the means of labor. Robot engineering will naturally be a catalyst to improving worker qualifications and skills. Under socialism, it will help man, serve him, but it will never become a source of unemployment and social conflicts, as is being observed even now in the world of capitalism.

A coordinated approach, a unification of the forces of CEMA member-nations -- this will help each of them and the entire community more quickly achieve success in this extremely important and complex matter and, in so doing, will help strengthen their technical-economic independence from the capitalist West.

[Caption to photo not reproduced for this report:] The CSSR has adopted and is actualizing a state target program for using industrial robots. Before 1985, various enterprises will receive registration papers for upwards of 3,000 robots and manipulators with programmed control. Czechoslovak specialists are working on this program in close contact with collectives of Soviet scientific research institutes. In the photo: an automated "helper" works in a shop in a machinebuilding plant in Ostrov-on-Ogrzh. It helps install parts weighing up to 100 kg on the streetcars produced here.

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ROBOTICS

KOMMUNAR AUTO PLANT DEVELOPS OWN ROBOTS

Moscow TRUD in Russian 7 Dec 83 p 2

[Article by A. Abdullin, TRUD correspondent, Zaporozhye: "Machines Replacing Manual Labor: Greetings Robot!"]

[Text] Robots have freed dozens of workers from heavy, monotonous labor at the Kommunar plant of the AvtoZAZ production association, which produces the popular Zaporozhets cars. Labor productivity has doubled, production standards have risen and production accidents have been eliminated entirely in the sectors where these steel "workhorses" are employed.

Naturally, everything does not come easily or simply to plant workers. But the Kommunar workers did not wait for mass production to turn out this equipment at specialized plants. They were first in the branch to decide to manufacture robots themselves. The enterprise trade-union committee did a great deal of work this past five-year plan to propagandize the introduction of robot equipment and to mobilize the plant scientific-technical community to resolve this task. Highly skilled specialists were assembled into a special bureau to study and analyze in detail the effectiveness of using robots at individual production sectors.

Plant workers first decided to introduce the new equipment at mechanical assembly sectors. But where to get "live" robots for this? They decided to use as a base a manipulator shown in 1978 at the USSR Exhibit of National Economic Achievements. Its electronic circuitry corresponded to the ideas of the Zaporozhye innovators. But it was decided to improve the mechanical portion. As a result, the first Kommunar "Brig-10-ZAZ" was born, developed in the plant technological design bureau and manufactured at the enterprise's machine-tool manufacturing shop. As of now, more than 50 of the robots have been introduced at enterprise shops. Each has replaced the labor of several workers.

"Introduction of this equipment at the Kommunar automotive plant and other enterprises of Zaporozhye Oblast is being done on the basis of target comprehensive programs to reduce manual labor and mechanize and automate production," says P. A. Nedobyvaylo, chairman of the Zaporozhye Oblast trade-union council. "The initiative of the plant workers in manufacturing robots themselves has therefore been supported at many of our enterprises."

Many oblast enterprises are now using extensively the experience of the Kommunar automotive plant. A number of plants and production associations have developed and are successfully operating departments, design bureaus and laboratories. In order to coordinate all these developments, a scientific-technical robot-engineering council has been organized in association with Zaporozhye Industrial Institute. The oblast plans to create a robot equipment technical servicing center in the future. Its tasks will be regular preventive inspections, and the centralized technical servicing and repair of manipulators installed in plant and factory shops. Such centralization will permit the effective use of highly skilled repair specialists and improvement in spare parts supply.

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APPLICATIONS OF BRIG-TYPE INDUSTRIAL ROBOTS VIEWED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, Mar 84 p 5

[Article by engineer G. G. Yeranov, "Experience in Introduction of Typical Robot Equipment Complexes"]

[Text] The wide use of industrial robots (PR) in production is difficult because work on developing and using PR is not interrelated enough. The technological, economic and social aspects of their use in production are not being properly developed. It is necessary to approach such work comprehensively.

The solution of the above-indicated problems is possible when PR or simply balanced manipulators are available at enterprises; these are hard to acquire and they are not reliable enough.

To reduce the scarcity of these mechanisms, it was decided to manufacture one model of the "Brig-10B" and the 30R-34M manipulator developed by the Chemical Machinebuilding Special Design Technological Bureau.

The VNIITnasosmash [All-Union Scientific Research Institute of Technology of Pump Machinebuilding] corrected individual units of the "Brig-10B" model taking into account conditions for utilizing series manufactured a UTsM-663 control device expanding thereby its possibilities considerably.

A combination of basic units of the "Brig" manipulator and the UTsM-663 cyclic control device made up a new model "Brig-VNM" automatic manipulator which they began to manufacture in 1982.

The "Brig-VNM" manipulator was intended to automate and mechanize auxiliary technological operations: loading, unloading, setting up and removing parts, as well as intermediate products from forge-stamping equipment.

Further, we will consider several versions of the VNIITnasosmash developments of robotized technological sets (RTK) using "Brig-VNM" robots and MP-9S

The creation of sections using PR requires additional technological equipment (storage devices, bunkers and orienting devices),which, naturally, leads to difficulties at the first stage of introduction. To solve this problem typical

projects and recommendations were developed for introducing RTK, including those for thread rolling cold-stamped bolts.

Specifications of RTK with "Brig-VNM" industrial robots

Machined parts	bolts
Size of machined parts, mm:	
diameter	8 to 24
length of parts	up to 150
Productivity, pieces/hour	300 - 400
Capacity of loading device, parts	400 - 800
Power consumption, kw	0.8
Area, meters^2	5

The first specimen of the robot-technological set for rolling threads on bolts was manufactured and introduced successfully in 1982 at the Kazan Compressor Plant, freeing two workers.

At present, the second RTK is being prepared for industrial start-up. The saving will be about 5000 rubles.

A typical version of the cold-stamping RTK was introduced at the "Vakuummash" Production Association. Typical parts in the first operation of the RTK are flat plates in the shape of squares, rectangles and circles.

Specifications of RTK with MP-9S

Machines parts	brackets, hooks, cups, corners
Maximum weight of part, kg	0.2
Productivity, pieces/hour	260 - 300
Number of intermediate products in magazine, pieces	250
Power consumption, kw	2.0
Area, meters^2	3

The introduction of RTK saves 15,000 rubles. The VNIITnasosmash jointly with the "Vacuummash" Production Association are working on expanding possibilities for introducing RTK for machining of several other types of parts.

The RTK presented above were introduced successfully in production and can be utilized further as typical at machinebuilding enterprises.

According to preliminary data, the introduction of the above-mentioned RTK is planned for 1983-1985, including: RTK for thread rolling at 18 enterprises and RTK for cold stamping at 12 enterprises.

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PROCESS CONTROLS AND AUTOMATION ELECTRONICS

ADAPTABLE ASUP DATA BASE ORGANIZATION UNDER DEVELOPMENT

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 1, Jan 84 pp 28-29

[Article by Candidate of Economic Sciences I. T. Rudnik: "Rational Organization of Standard Reference Data in an Automatic Installation Control System"]

[Text] Rational organization of standard reference data (NSD - SRD) is one of the directions of improvement of an ASUP's [Automatic Installation Control System] information retrieval, since the efficiency of existing and developing automatic systems depends, to a large extent, on a correct solution to this problem. Solving this problem with automation of processes controlling machinebuilding production shows that a necessary condition and very important precondition of rational SRD organization is a systematic approach to its realization, i.e., to the development and implementation of SRD.

Data, including standard reference data, may be organized interdependently by a system based on the principles of a data bank. The data bank may consist of one or more data bases. It is not advisable to join all data processed at an ASUP into one data base. This reduces the efficiency of the ASUP's data bank design, and complicates management and use of the data base. A more rational approach is to subdivide the ASUP's information base into several data bases. Regardless of the principles of data distribution among the data bases, it is considered essential to single out one special global data base.

Its function is to amalgamate the local data into a uniform ASUP information base. The global data base is called on to make separate subsystems interdependent. The relations between the global and local data bases may be rather complex and vary in each ASUP.

We hold that a standard reference data base (SRDB) should be used as the global data base.

A SRDB eliminates data duplication in the ASUP's local data bases and holds a special position in the ASUP's data bank. SRD blocks form the basis of information blocks, subject to long-term storage in main memory. SRD blocks play a linkage role in an automatic system, and are also used to solve practically any ASUP problem. Thus, normative data on operational time and value norms are included in calculation of production capacity and salary

funds, determination of the target worker strength, recording of labor and salary, production cost accounting and in many other calculations. This is confirmed by the experience of using SRD for automatic processing of economic information at the Frezer Plant and Clock Plant No 2 in Moscow, where 40-50 percent of the correlated information of various functional tasks of the ASUP is provided, even at the level of SRD local block creation. However, local SRD blocks cause considerable duplication of information. Thus, 30-35 percent of the Frezer Plant's data is duplicated, and more than 40 percent at Clock Plant No 2. Queries to the SRD come from all local data bases of the ASUP data bank. This makes the SRD base the nucleus of the ASUP's information base. We observe that the creation of a global SRD base is highly advisable in ASU [Automatic Control System] of enterprises with serial and mass production, which are characterized by partial redundancy of output production and engineering processes and, consequently, by a high SRD stability.

A global SRD base is very important in the functioning of the ASUP's data bank, which depends on the characteristics of SRD management and use, and the frequency of referencing of the SRD base. All this ascribes the task of effective organization of the global SRD to a number of very important ASUP data bank design tasks.

It does not follow from the above, however, that all SRD aggregates existing in the ASUP should be included in the global SRD base. Practice has shown that SRD blocks may be of two types.

The first type of block, consisting of logically related data, is used frequently for solving various problems; these blocks typically contain the subjects of labor and output production, equipment composition and other information.

Blocks of the second type are practically independent of each other and are used basically for solving local problems. Examples of these blocks are reference books of workers' surnames, lists of the enterprise's subdivisions, customers of distributors, etc.

As criteria for ascribing a SRD block to one of the two mentioned types it is advisable to use the following: interdependence with other blocks: a - joint processing and b - inclusion of like-named elements in different blocks; multidimensional use (use of various elements of a given block in different tasks); frequency of use (periodicity of a block's inclusion in calculations and use with different problems).

This system of selecting SRD according to the criteria may be formalized by means of the following set theory model.

Let there be a set

$$A = \{a_1, a_2, a_3, \ldots, a_N\}$$

of elements, and a set

$$D = \{d_1, d_2, \ldots, d_j, \ldots, d_S\}$$

of block descriptions,
then

$$m_j \Rightarrow \underset{d_l}{V_{al}}$$

is the jth block, and the set

$$M = \bigvee_{j=1}^{S} m_j$$

is the SRD stock.
We introduce the Boolean functions

$$\varphi'(m_{j1}, m_{j2}) = \begin{cases} 1, \text{ если } m_{j1} \text{ и } m_{j2} \text{ обрабатываются совместно} \\ 0 - \text{в противоположном случае} \end{cases}$$

$$\text{и } \varphi_1(m_{j1}) = \bigcup_{j=2} \varphi'(m_{j1}, m_{j2}).$$

Key:
1, if m_{j1} and m_{j2} are processed together
0, if the opposite is true

The function φ_1 determines whether block m_{j1} is processed jointly with other blocks.

We assume that block m_{j1} has elements in common with other blocks. Let n_{j1j2} be the number of common elements in blocks m_{j1} and m_{j2}, and K_{nj1j2} be the number of blocks with which block m_{j1} intersects at n_{j1j2} elements. We introduce the Boolean function

$$\varphi_2(m_{j1}) = \begin{cases} 1, \text{ если } \Sigma n_{j1j2} K n_{j1j2} \geqslant \text{const}, \\ 0 - \text{в противоположном случае}. \end{cases}$$

Key:
1. if
2. the opposite is true

The function φ_2 evaluates the degree of duplication of the elements of block m_{j1}, taking into account the number of repeating elements, as well as blocks having elements in common with the given block.

Functions φ_1 and φ_2 together formalize the first criterion of the analyzed criterial system of ascribing a SRD block to one of the above-mentioned types.

We introduce the function

$$\varphi_3(m_{j1}) = \begin{cases} 1, \text{ если массив } m_{j1} \text{ обрабатывается задачами} \\ \text{в нескольких аспектах}, \\ 0 - \text{в противоположном случае}. \end{cases}$$

Key:
1, if block m_{jl} is processed by tasks in several aspects,
0, if the opposite is true

Function φ_3 formalizes the second criterion of the analyzed criterial system.

We introduce the function

$$\varphi_4(m_{jl}) = \begin{cases} 1, \text{ если частота использования массива } m_{jl} \\ \text{больше определенной заранее величины,} \\ 0 \text{ — в противоположном случае.} \end{cases}$$

Key:
1, if the frequency of use of block m_{jl} is great-r than the previously determined magnitude,
0, if the opposite is true.

Function φ_4 formalizes the third of the proposed criteria.

We also introduce the function

$$F(m_{jl}) = \bigcup_{i=1}^{4} \varphi_i(m_{jl}).$$

Thus, Function F is the integral evaluation which formalizes the system as a whole.

If $\exists l$ such that

$$F(m_l) = 1,$$

then m_l is a block of the first type.

Then $M' = \{m_l, \ldots\}$ is the set of blocks of the first type, and $M'' = M/M'$ is the set of blocks of the second type.

The composition of blocks of the first type is subject to inclusion in the global SRD base. Blocks of the second type determine the composition of the SRD, which should be included in local data bases.

The practical use of the proposed model depends on the establishment of specific numeric values for the constants used in it (in functions φ_2 and φ_4). These numeric values may be obtained by the method of expert evaluations based on the ASUP's design know-how in specific branches of the economy; in so doing, the nature of production at the enterprise for which the data bank is being created should be taken into consideration.

The devised set model makes it possible to solve the task of determining the composition of the global SRD base, which is the initial design stage of this

data base.

Organization of the ASUP's SRD in the form of a data base will make it possible to achieve a considerable economic result, expressed in the possibility of flexible system development, reduction of problem-solving time, minimization of information flows in the ASUP, increase of the SRD's quality and reliability, reduction of data-preparation time and other factors. The interdependent organization of SRD will make it possible to achieve the requisite integration of data storage, considerably reduce the labor consumption and cost of operation, and eliminate data duplication. This is precisely why work is currently underway in this direction at a number of machinebuilding enterprises and production associations. This approach to the rational organization of SRD will substantially increase the efficiency and quality of the ASUP's information retrieval.

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INTEGRATED FUNCTIONS OF CAM AT VORONEZH PLANT VIEWED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, Feb 84
p 29

[Article by engineer N. M. Babenko, candidate of technical sciences N. I. Predkin: "Standardization of CAMS Software Components of a Machinebuilding Enterprise"]

[Text] Typical problems in automating control systems for machinebuilding enterprises (ASUP) [CAMS-computer-aided manufacturing systems] are calculating the labor-intensiveness of making production programs for shops for various time intervals, the loading and transit capacity of equipment, the planned number of basic production workers (for shops, trades and categories), basic material requirements according to the production program, part tasks for shops, etc. This requires considerable material and labor expenditures for developing algorithms, programing, testing, checking-out on the computer and incorporating the programs into production.

The solution of such problems, as a rule, is based on the information summaries formed by subsystems programs for controlling the technical preparation for production (UTPP) which provide all possible calculations for one product (determination of the applicability of parts and assembly units in a product, the calculation of a labor-intensiveness norm for shops and groups of equipment, the calculation of material consumption for a product in a specific and composite list of products, etc.). UTPP problems are solved regularly in connection with design and technological changes, and the starting-up production of new product models.

How is one typical CAM problem, the calculation of material resource requirements in specific and composite lists of products for a production program, solved at present? The applicability of parts and assembly units in the product and the material consumption for specific and composite lists of products are determined for each product of the production program. Files of obtained data are stored on tapes. A set of programs for calculating material requirements implements data recording and monitoring, and processing them with data files obtained in the UTPP (actual selection, multiplication and addition of corresponding values) and, finally, prints out the results. The apparent simplicity should not, however, hide the fact that the development of such programs requires considerable labor and material expenditures.

By the way, it is possible to exclude a stage of developing, checking-out and modifying a number of programs and correspondingly change the technology of doing calculations on the computer by using the method of "designing" an arbitrary (fictitious) product of any complexity, including an arbitrary set of design components.

The design specification of a product, i.e., its composition, is stored on tape in the form of product codes ("where used"), of the design component that enters into the product ("what is included"), the name of the design component, the quantity of the design components that are included in the product (assembly unit) according to kinds of execution (ordinary, for export, tropical versions). Other data may also be indicated.

A fictitious product "where used" is designed with an arbitrary code, whereas design components ("what is included") codes of all products in the production program are enumerated. The quantity of these products (of respective kinds) in the program is indicated in the "Number of design components" data file. The determination of the applicability of parts and assembly units in the product of such an artifically built product on the computer (its "design" does not mean, of course, that a real object is obtained; only that some model is designed in the computer memory) makes it possible to obtain some concept on the full applicability of parts and assembly units in the articles of the production program. The implementation of corresponding UTPP programs for such a product makes it possible to obtain a number of indicators for the production program (machines, combined labor-intensiveness, material consumption, etc.).

Let, for example, some production program include 20 units of article No 1, 100 units of article No 2, 15 units of article No 3, and 5 units of article No 4. We will design article No 5, including article No 1(20 units) as an assembly unit, article No 2(100 units), article No 3(15 units) and article No 4 (5 units). The determination of the applicability of parts and assembly units for article No 5 on the computer makes it possible to include in article No 5 all components with respective quantities of articles Nos 1, 2, 3 and 4. Solving the UTPP problem, for example, with respect to the material consumption for article No 5 determines the material requirements for the production program.

The proposed approach is used widely at the Voronezh Production Association for Forging-Press Equipment imeni M. I. Kalinin. This makes it possible to do away with a stage of developing, checking-out and introducing programs for a series of CAM problems by using the UTPP programs for a "fictitious" article, save the disk memory of the computer, needed for storing programs and reduce the number of original program solutions of functional results. The technology for calculating on the computer also changes; surplus operations on preparing data are eliminated and the form of the output document are standardized.

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